

# Overview



## Features:

- **Apple M1 Chip:**
  - 8-core CPU with 4 performance cores and 4 efficiency cores
  - 7 or 8-core GPU
  - 16-core Neural Engine
- **Retina Display:** 13.3-inch (diagonal) LED-backlit display with IPS technology; 2560-by-1600 native resolution at 227 pixels per inch with support for millions of colors.
- **Ports:** Two Thunderbolt / USB 4 ports. .
- **Input Devices:** Force Touch Trackpad and keyboard with scissor mechanisms.
- **Finishes:** Space Gray, Silver, and Gold.

## What's New:

- **Apple Silicon:** The [Reference Guide for Mac Computers with Apple Silicon](#) (TP1900) is your primary resource to get up to speed on Apple Silicon. Detailed information is provided in the following sections of the reference guide:
  - Apple Silicon Technology Overview
  - Quick Start Guide
  - Frequently Asked Questions (FAQ)
  - Service Considerations for Mac Computers with Apple Silicon
  - How to Identify Mac Computers with Apple Silicon
  - Additional Resources

## Important Service Considerations

This computer model's design requires special service considerations:

- **Battery:** The [battery](#) (RP1681) is a replaceable part. Find information about [battery health management](#), a feature designed to improve the lifespan of your Mac notebook's battery.
- **Speakers:** The [speakers](#) (RP1680) must be replaced as a pair.
- **Trackpad:** The [trackpad](#) (RP1689) is a replaceable part.
- **System Configuration for Mac Computers with Apple Silicon:** Completing the [System Configuration suite](#) (TP1901)

is required for the display, logic board, and Touch ID board procedures. Run the System Configuration suite to configure the replacement part with the computer.

- **Trackpad Calibration:** The trackpad must be [calibrated](#) (TP1314) after every repair.
- **Audio Board:** When replacing the audio board, be sure to order the correct part color, which can be found in the [Exploded View](#) (TP1902).
- **Heat Spreader:**
  - The heat spreader is not a separate part on MacBook Air (M1, 2020). Do not attempt to remove the heat spreader from the logic board.
  - There are two types of heat spreader. The 7-Core GPU has a thinner heat spreader with no graphite, while the 8-Core GPU has an extra layer of graphite foam.
  - The configuration of the bottom case is dependent on the style of the heat spreader. Always use the serial number when ordering a replacement bottom case to make sure you get the correct part.
- **Vent/antenna module:** The vent/antenna module is attached to the top case with strong tape. The replacement part will come with new tape and new vent/antenna gaskets. Be sure to follow the instructions in the [vent/antenna module repair article](#) (RP1679) for when to use these parts.

## macOS

This computer ships with a model-specific version of macOS. [Use the Mac operating system that came with your Mac or a compatible newer version](#) to check that the system build is correct for this computer model. Using Software Update, check for and apply the latest software and firmware updates.

When replacing the logic board, it is necessary to run [Apple Configurator 2](#) after [System Configuration](#) is completed successfully. Apple Configurator 2 will install the latest macOS and firmware.

## Ports:

- Audio Port
- Thunderbolt / USB 4 ports



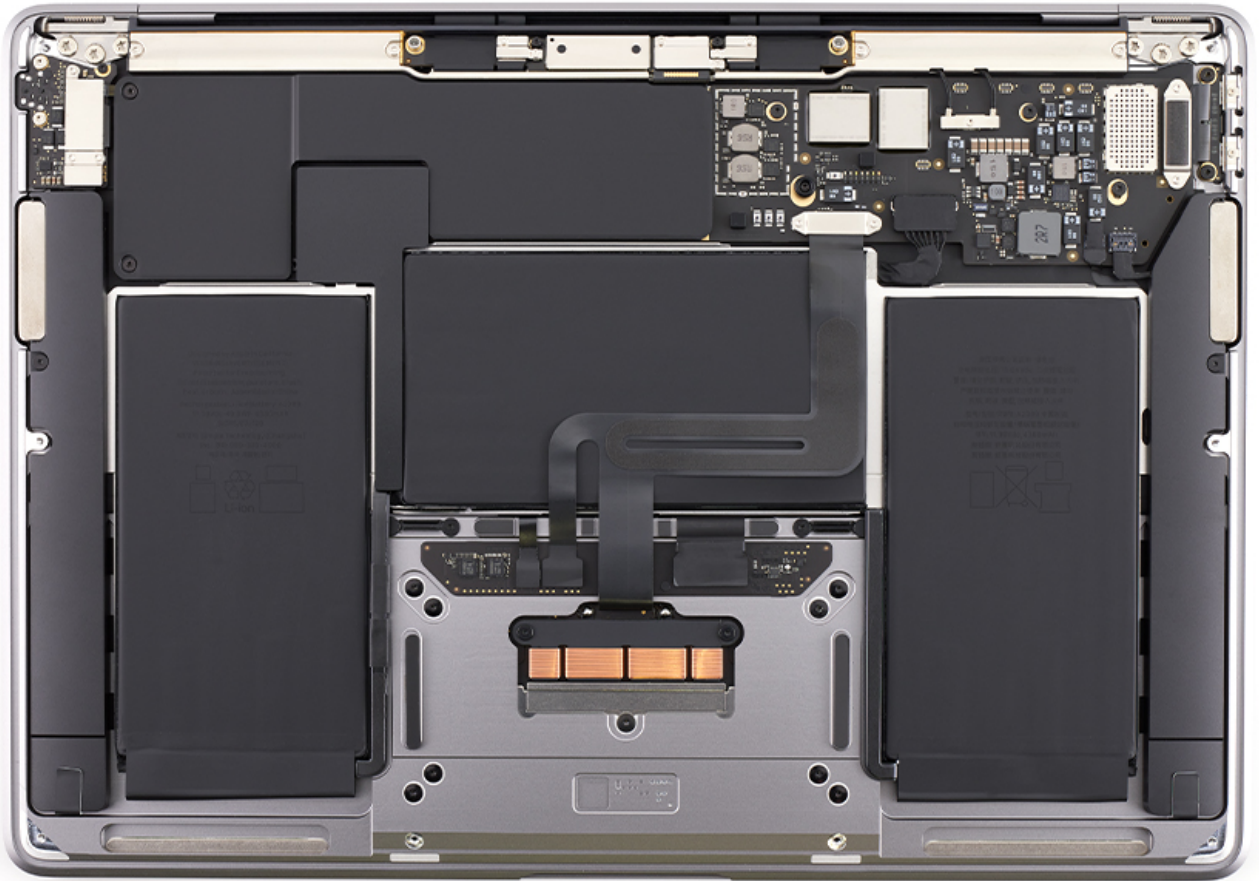
## Bottom Case

- **Model Number:** A2337
- **EMC Number:** 3598





**Internal View:**



## Fixtures and Special Tools

- Torque driver, adjustable, 10–34 Ncm (923-02995)
- T5 Bit, 1/4" hex, 25 mm (923-02996)
- Torque driver, adjustable, 0.3–1.2 Nm (923-0735)
- Battery and speaker adhesive (076-00467)
- Protective battery cover (923-03021)



- iPhone Display Press (661-08916)



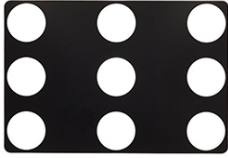
- Battery press plate and support frame (923-03007)



- Trackpad gap offset tool (923-02998)



- Weight Placement Rubber Template (923-02462)



- Touch ID alignment tool kit (923-03032)



# Reference Guide for Mac Computers with Apple Silicon

## Contents of this article:

- [Apple Silicon Technology Overview](#)
- [Quick Start](#)
- [Service Considerations](#)
- [Frequently Asked Questions \(FAQ\)](#)
- [How to identify a Mac with Apple Silicon](#)
- [Additional Resources](#)

## Apple Silicon Technology

Apple introduces the first Apple silicon designed specifically for the Mac. As a system on a chip (SoC), M1 combines numerous powerful technologies into a single chip, and features a unified memory architecture for dramatically improved performance and efficiency. Many of the technical procedures required to troubleshoot and repair an Intel-based Mac are still relevant for a Mac with Apple silicon. However, some things have changed, such as no SMC or NVRAM resets, a new startup options screen, simplified System Configuration workflow, and more. You'll want to think different when it comes to troubleshooting and repairing a Mac with Apple silicon.



## Quick Start

This chart will help you quickly identify similarities and differences between a Mac with Apple silicon and previous Intel-based Mac computers. In-depth details related to each topic are provided in the other sections of this article.

Topic	Apple Silicon	Intel	Summary
<b>Startup options</b>	Press and hold the power button for 10 seconds.	Press and hold the Option (Alt) key immediately after turning on or restarting your Mac.	Startup options is a new interface to access macOS Recovery, choose a startup disk, launch Diagnostics Mode, and more.
<b>macOS Recovery</b>	From startup options, select the Options gear, then Continue.	Press the power button, then immediately press and hold the Command ( ) and R key.	Familiar UI and utilities such as Disk Utility and Reinstall macOS. Disk Sharing is a new utility for Mac computers with Apple silicon.

Topic	Apple Silicon	Intel	Summary
<b>Launch Diagnostics</b>	From startup options, press and hold the Command ( ) and D key.	Press the power button, then immediately press and hold the Option and D key.	Simplified UI makes it easy to start up to Diagnostics Mode.
<b>Safe Mode</b>	From startup options, hold the Shift key while you click the startup disk you want to start up from.	Press the power button, then immediately press and hold the Shift key.	<a href="#">Safe Mode</a> (HT201262) may help you diagnose problems.
<b>Disk Sharing</b>	From macOS Recovery, choose Utilities > Share Disk.	Press the power button, then immediately press and hold the T key.	Connect a Mac with Apple silicon to another computer using a Thunderbolt or USB-C cable to access files.
<b>Diagnostic suites and tests</b>	OS only	EFI and OS	All diagnostic tests and suites are now OS based, can be interactive, and no local net boot server is required because the diagnostic resources are served from the cloud.
<b>Reset the SMC</b>	Not required.	Press and hold all of the following keys: Control on the left side of your keyboard, Option (Alt) on the left side of your keyboard, and Shift on the right side of your keyboard. Then press and hold the power button as well.	No need to reset the SMC on a Mac with Apple silicon.
<b>Reset NVRAM or PRAM</b>	Not required.	Shut down the Mac, then turn it on and immediately press and hold these four keys together: Option, Command, P, and R.	No need to reset NVRAM on a Mac with Apple silicon.
<b>System Configuration</b>	Simplified process. No Host computer or DFU mode required.	Host computer, MCU, and DFU mode.	<a href="#">System Configuration for Mac Computers with Apple Silicon</a> streamlines the repair completion workflow.  The workflow for <a href="#">System Configuration for Mac computers with the Apple T2 Security Chip</a> remains the same.
<b>Displays</b>	Supports one display up to 6K resolution at 60Hz.	Display support for multiple displays at various resolutions.	Refer to the <a href="#">tech specs</a> for full display support information.
<b>Apple Configurator 2</b>	New use cases to revive and restore. Required after logic board replacement.	Used to revive and restore Mac computers with the Apple T2 Security Chip.	New use cases for if a Mac computer with Apple silicon becomes unresponsive and the firmware and software must be revived or restored. Refer to the Service Considerations section below for additional information.

## Service Considerations

### Diagnostics

- To enter Diagnostics Mode on a Mac with Apple silicon, hold the power button for 10 seconds to start up to startup options, then press and hold Command ( ) + D.
- The Mac diagnostic categories in the AST 2 Diagnostic Console have been streamlined to match the categories found

in Diagnostics for iOS. The three diagnostic categories are Triage, Tools, and Post-Repair.

- Refer to [TP1909: Diagnostics for Mac Computers with Apple Silicon](#) for additional details, including:
  - diagnostic suites and tests available in each of the three categories
  - when you should run a diagnostic suite or test
  - which diagnostics you should run after a repair procedure
- The language selection for Diagnostics Mode on the user's computer is determined by the language setting in the user's macOS. If you need to change the language for Diagnostics Mode, start up to the user's macOS and select the desired language.
- Ensure the computer is shutdown after you have finished running diagnostic tests and suites. A Mac with Apple silicon will remain at the Waiting for Support screen in Diagnostics Mode even when the Diagnostic session in the AST 2 Diagnostic Console has been archived. This will cause the battery on a notebook to drain, even if the display is closed.
- If you encounter unexpected behavior when attempting to enter Diagnostics Mode or when running diagnostics, check for [known diagnostic issues](#) before escalating to Channel Service Support (CSS).

## System Configuration

- [System Configuration for Mac Computers with Apple Silicon](#) has been simplified from the process used for [Mac computers with the Apple T2 Security Chip](#).
- You don't need a host computer to run System Configuration on a Mac with Apple silicon. Also, you don't need to put the computer into DFU mode.
- After a logic board repair, the Mac will chime twice on startup until the System Configuration suite is run. This is expected behavior.
- A computer or internet device is still needed to initiate a diagnostic session using the [AST 2 Diagnostic Console](#).

## Apple Configurator 2

- Apple Configurator 2 has the following new use cases:
  - Revive or restore a Mac with Apple silicon that may have failed an update, installation, or reinstallation from macOS Recovery.
  - Complete a logic board repair after successfully running the System Configuration suite, by installing the latest versions of macOS and macOS Recovery.
- Find additional details on [when to use Apple Configurator 2](#).
- The ports used to place a Mac with Apple silicon in DFU mode are different than what's used for an Intel-based Mac. Pay close attention to which port you are using whenever DFU mode is required.

## Frequently Asked Questions (FAQ)

### Startup

#### **I hear the startup chime. Can I rely on this for troubleshooting?**

The return of the startup chime is exciting, however don't rely on it for troubleshooting as there is now an option to turn it on or off in System Preferences > Sound.

#### **The keyboard and mouse don't seem to be working when the computer is starting up. How can I fix this?**

Good news! Nothing to fix! Your favorite key combinations will still be used for Intel based Mac computers, such as SMC reset, PRAM reset, safe mode, etc., however they are no longer required for Mac computers with Apple silicon.

### Startup Options

#### **The startup options window on a Mac with Apple silicon looks like Startup Manager on an Intel-based Mac. Are they the same?**

While [startup options](#) and [Startup Manager](#) both allow you to select a different startup disk the similarities end there. Startup options allows you to start up to macOS Recovery, launch Diagnostics mode, and choose a startup disk to start up in Safe Mode. Think of startup options as the bridge to the different environments you'll use for troubleshooting.

### Reinstalling macOS

#### **How do I start up to macOS Recovery?**

Hold the power button for 10 seconds. Select the Options gear, then Continue to start up to [macOS Recovery](#)

#### **Can I still access Internet Recovery?**

If you can't start up to macOS or macOS Recovery, attempt to revive the computer. Refer to the [Apple Configurator 2 User Guide](#) and follow the revive instructions to update the firmware and macOS Recovery to the latest version.

### Repair

#### **Do I still need to run System Configuration to complete certain repair procedures?**



Yes. You still need to run the [System Configuration suite](#) after installing some replacement parts. However, the process has been simplified for a Mac with Apple silicon.

#### **Do I need to put a Mac with Apple silicon in DFU mode to run System Configuration?**

No. For repair procedures that require System Configuration, with the exception of a logic board, a Mac with Apple silicon will start up to macOS. When you replace a logic board, the computer will automatically start up to diagnostics mode.

#### **Data Transfer**

**I want to show a user how to transfer data to another Mac, but it doesn't appear over Wi-Fi. What should I do?**

[Disk Sharing](#) requires a connection to another Mac with either a USB or Thunderbolt cable.

#### **Diagnostics and Troubleshooting**

**I'm holding the Shift key during startup to enter Safe Mode, but nothing happens. Has Safe Mode changed?**

[Safe Mode](#) hasn't changed, but the method to start up in Safe Mode has. To start up the computer in Safe Mode, hold the power button for 10 seconds to enter startup options. Then, hold Shift while selecting the desired startup volume.

**Note:** Safe Mode is helpful when validating a possible software issue.

**I'm holding the Command ( ) and D keys during startup, but can't get into Diagnostics Mode.**

Start up the Mac to startup options, then press and hold the Command ( ) and D keys to enter Diagnostics Mode.

**Note:** You'll still use the Apple Service Toolkit 2 (AST 2) Diagnostic Console to initiate and run diagnostics tests and suites on the user's computer.

#### **SMC and NVRAM resets**

**Why can't I reset the SMC on a Mac with Apple silicon?**

While it's still technically possible, the likelihood that you'll need to reset the SMC is incredibly low. The Apple silicon system on a chip (SOC) handles all of the communication previously managed by the System Management Controller (SMC). Because of this, and similar to iOS devices, a shutdown will resolve most issues related power, battery, fans, and other features.

**What about NVRAM? Isn't it possible for that information to become corrupt?**

Similar to the SMC reset, it's unlikely that you'll need to reset NVRAM on a Mac with Apple silicon because the settings that are stored in NVRAM, such as sound volume, display resolution, startup disk selection, etc., are now stored in the System region of the storage volume.

### **How to Identify a Mac with Apple Silicon**

- Choose About this Mac from the Menu. The description of a Mac with Apple silicon includes the Apple chip name, for example: Apple M1.
- Mac notebooks with Apple silicon have a globe icon on the Fn (Function) key.
- Mac mini (M1, 2020) has two Thunderbolt / USB 4 ports.

# Diagnostics for Mac Computers with Apple Silicon

This article provides details for running diagnostics on Mac computers with Apple silicon. Diagnostics are critical to properly diagnose, troubleshoot, repair, and validate a repair for Mac computers.

## Contents of this article:

- [Overview](#)
- [What's New](#)
- [AST 2 Diagnostic Console Categories](#)
- [Diagnostics Required Based on Repair Procedure](#)
- [Additional Resources](#)

## Overview

Understanding the difference between a diagnostic suite, a diagnostic test, and a diagnostic tool, will help you determine which is most appropriate to run and when, depending on the stage of the repair process. The fundamental aspects of diagnostics include:

- **Apple Service Toolkit 2 (AST 2):** a cloud-based system that contains the diagnostic suites, tests, and tools.
- **AST 2 Diagnostic Console:** a web application used to initiate the diagnostic suites and tools on a user's device, as well as view the results of each.
- **Suite:** a collection of tests that are run at the same time.
- **Test:** single test for a specific part or feature.
- **Tool:** used to complete a repair or perform a specific task.

## What's New

A new infrastructure for AST 2, similar to what's available for iOS, enables simpler, faster, and easier to use diagnostics for Mac computers with Apple silicon. The process of running diagnostics is similar to previous Intel-based Mac computers, however there are new features and benefits specific to Mac computers with Apple silicon:

- User-friendly interface to enter Diagnostics Mode. Hold the power button for 10 seconds to get to Startup Options, then hold Command + D.
- Wi-Fi is now the standard connection method since AST 2 can now interact with frameworks installed in macOS Recovery. Ethernet can still be used.
- OS based diagnostics are often faster than the EFI diagnostics required for Intel-based Mac computers.
- All diagnostics are OS based.
- Many interactive prompts now appear on the user's computer instead of the AST 2 Diagnostic Console.
- Similar to iOS, the AST 2 Diagnostic Console has been streamlined into the following three categories:
  - Triage
  - Tools
  - Post-Repair

## AST 2 Diagnostic Console Categories

### Triage

The Triage category of the AST 2 Diagnostic Console contains suites intended to quickly identify, confirm, and verify potential hardware issues. It's important to remember that Triage doesn't just take place at the beginning of a repair. You may replace a part and then discover a new issue. You'll need to use the Triage diagnostics to identify the part causing the new issue. The following quick checks can be run with the user to help confirm the reported hardware issue.

**Important:** Run MRI anytime a computer will be checked in for repair.

- MRI
- Display Anomalies
- Image Persistence
- Keyboard
- Power Adapter
- Touch ID
- Touch Bar Response
- Touch Bar Pixel Anomalies
- Trackpad
- Cooling System
- Graphics and Display
- Audio
- Memory
- Full System Diagnostic

**Note:** Full System Diagnostic can be run prior to a repair to help you identify intermittent hardware issues.

## **Tools**

The Tools category contains the [System Configuration suite](#) which must be run to complete a repair of a display, logic board, top case, or Touch ID board.

## **Post-Repair**

The Post-Repair category contains the diagnostic suites used to validate a repair, such as Post-Repair Diagnostic and Trackpad Calibration Check.

## **Diagnostics Required Based on Repair Procedure**

After completing a repair on a Mac with Apple silicon, consult the charts below to determine which post-repair diagnostics to run.

### **Mac Notebooks with Apple Silicon**

Module	Repair Completion	Post-Repair Verification
Audio Board Audio Board Flex Assembly Audio Board Flex Cable	—	<ul style="list-style-type: none"> <li>• Audio</li> <li>• Post-Repair Diagnostic</li> <li>• Trackpad Calibration Check</li> </ul>
Battery	—	<ul style="list-style-type: none"> <li>• Post-Repair Diagnostic</li> <li>• Trackpad Calibration Check</li> </ul>
BMU Flex Cable	—	<ul style="list-style-type: none"> <li>• Post-Repair Diagnostic</li> <li>• Trackpad Calibration Check</li> </ul>
Bottom Case	—	<ul style="list-style-type: none"> <li>• MRI</li> <li>• Trackpad Calibration Check</li> </ul>
Display	<ul style="list-style-type: none"> <li>• <a href="#">System Configuration</a></li> </ul>	<ul style="list-style-type: none"> <li>• Post-Repair Diagnostic</li> <li>• Trackpad Calibration Check</li> </ul>
eDP Flex Cable	—	<ul style="list-style-type: none"> <li>• Post-Repair Diagnostic</li> <li>• Trackpad Calibration Check</li> </ul>
Fan(s)	—	<ul style="list-style-type: none"> <li>• Post-Repair Diagnostic</li> <li>• Trackpad Calibration Check</li> </ul>
I/O Board	—	<ul style="list-style-type: none"> <li>• Post-Repair Diagnostic</li> <li>• Trackpad Calibration Check</li> </ul>
IPD Flex Cable	—	<ul style="list-style-type: none"> <li>• MRI</li> <li>• Keyboard</li> <li>• Trackpad Calibration Check</li> </ul>
Logic Board	<ul style="list-style-type: none"> <li>• <a href="#">System Configuration</a></li> <li>• Use <a href="#">Apple Configurator 2</a> to update firmware and install latest macOS.</li> </ul>	<ul style="list-style-type: none"> <li>• Post-Repair Diagnostic</li> <li>• Trackpad Calibration Check</li> </ul>
Speakers	—	<ul style="list-style-type: none"> <li>• Post-Repair Diagnostic</li> <li>• Trackpad Calibration Check</li> </ul>
Top Case	—	<ul style="list-style-type: none"> <li>• Post-Repair Diagnostic</li> <li>• Keyboard</li> <li>• Trackpad</li> <li>• Touch Bar Response</li> <li>• Touch Bar Pixel Anomalies</li> <li>• Trackpad Calibration Check</li> </ul>
Top Case with Battery	<ul style="list-style-type: none"> <li>• <a href="#">System Configuration</a></li> </ul>	<ul style="list-style-type: none"> <li>• Post-Repair Diagnostic</li> <li>• Keyboard</li> <li>• Trackpad</li> <li>• Touch Bar Response</li> <li>• Touch Bar Pixel Anomalies</li> <li>• Trackpad Calibration Check</li> </ul>
Touch ID Board	<ul style="list-style-type: none"> <li>• <a href="#">System Configuration</a></li> </ul>	<ul style="list-style-type: none"> <li>• Post-Repair Diagnostic</li> <li>• Touch ID</li> <li>• Trackpad Calibration Check</li> </ul>
Touch ID Shim	—	<ul style="list-style-type: none"> <li>• MRI</li> <li>• Touch ID</li> <li>• Trackpad Calibration Check</li> </ul>
Trackpad Trackpad Flex Cable	—	<ul style="list-style-type: none"> <li>• Post-Repair Diagnostic</li> <li>• Trackpad Calibration Check</li> </ul>
Vent/Antenna Module	—	<ul style="list-style-type: none"> <li>• Post-Repair Diagnostic</li> <li>• Trackpad Calibration Check</li> </ul>

**Mac Desktops with Apple Silicon**

Module	Repair Completion	Post-Repair Verification
Antenna Plate	—	• MRI
Bottom Cover	—	• MRI
Coin Cell Battery	—	• Post-Repair Diagnostic
Fan(s)	—	• Post-Repair Diagnostic
Housing	—	• Post-Repair Diagnostic
I/O Wall	—	• Post-Repair Diagnostic
Logic Board	<ul style="list-style-type: none"><li>• <a href="#">System Configuration</a></li><li>• Use <a href="#">Apple Configurator 2</a> to update firmware and install latest macOS.</li></ul>	• Post-Repair Diagnostic
Power Supply	—	• Post-Repair Diagnostic
Speakers	—	• Post-Repair Diagnostic

# Serial Number Location

## System Serial Number

The system serial number is etched on the bottom case near the hinge.



## Transferring the Serial Number

Use a fine-tip permanent marker to write the system serial number on the inside of the bottom case.





X00YY0XYXY00

# Portables (Mid 2012 and later) Battery Safety Setup

Battery Safety Setup for MacBook, MacBook Air, and MacBook Pro (Mid 2012 and later)



**Warning:** Before servicing a portable computer, read and understand [OP24: Safely handling lithium batteries and lithium battery-powered devices](#).

For information on how to set up your workstation, refer to [OP685: Embedded battery workstation setup for Apple notebook computers and iPhone](#).

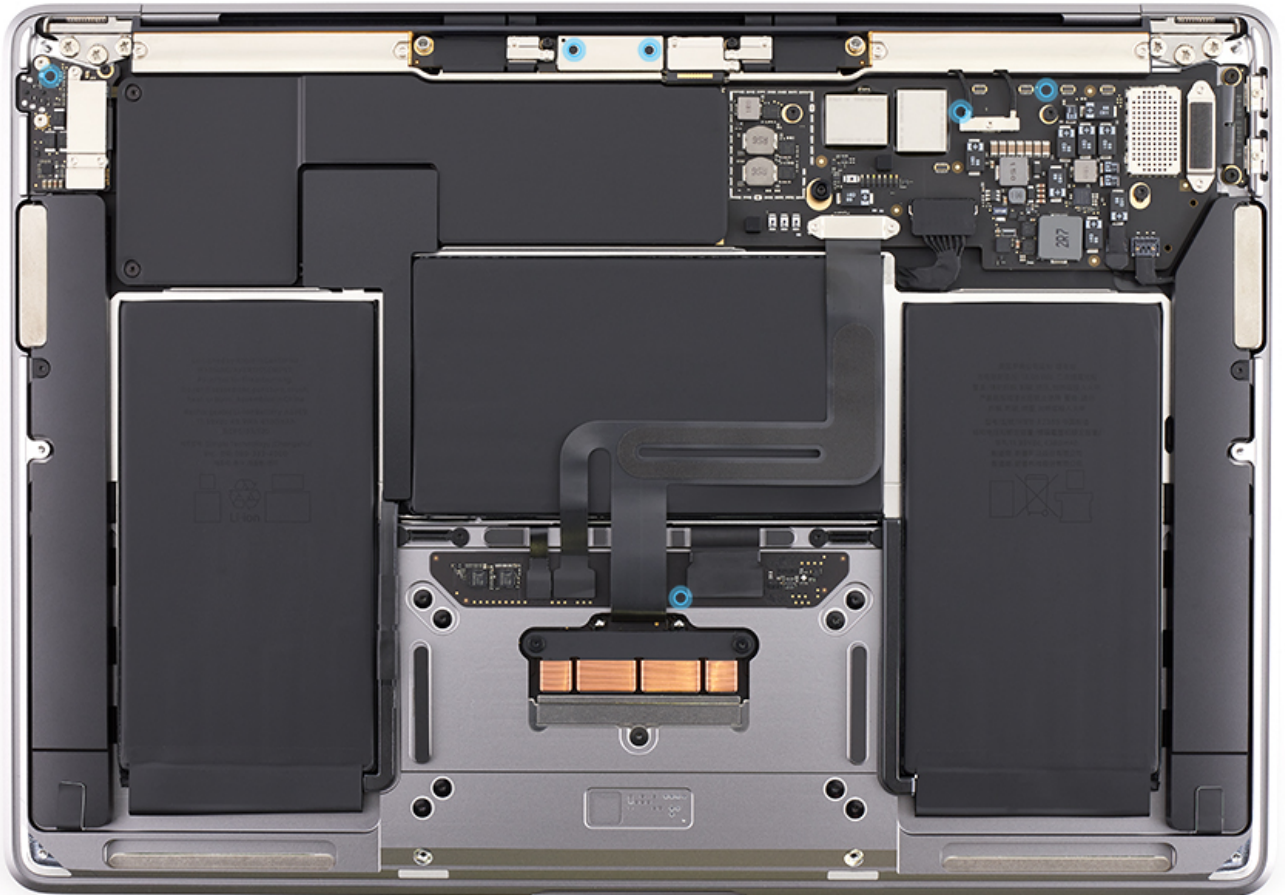
## Visual/Mechanical Inspection (VMI) Guide for Mac - Table of Contents

- [Displays](#)
- [Liquid Contact](#)
- [Notebook Power Adapters](#)
- [Notebook USB-C Cables](#)

# Liquid Contact Indicators

## Liquid Contact Indicators for MacBook Air (M1, 2020)

The top case includes spill sensors called liquid contact indicators (LCIs) to help discover accidental damage to the computer. The sensors are visible only when the bottom case has been removed. The LCIs are visible with an ultraviolet flashlight (UV) when they have come in contact with liquid, such as an accidental spill.



# How to Read Liquid Contact Indicators with Ultraviolet (UV) Light

## How to Read Liquid Contact Indicators with Ultraviolet (UV) Light

MacBook (Retina, 12-inch, 2017), MacBook Air (Retina, 13-inch, 2018 and 2019), MacBook Air (M1, 2020), MacBook Pro (2018, 2019, and 2020), and MacBook Pro (13-inch, M1, 2020) contain spill sensors called liquid contact indicators (LCIs). LCIs help discover accidental damage to the computer. They are black, and liquid contact is only visible with the use of a UV light. LCIs appear black under normal light and glow blue when highlighted with a UV light. They turn pink or produce a pink halo when they come in contact with liquid.

**Note:** MacBook Pro (15-inch, 2018 and 2019) also has one LCI that appears white and turns pink when it comes in contact with liquid.

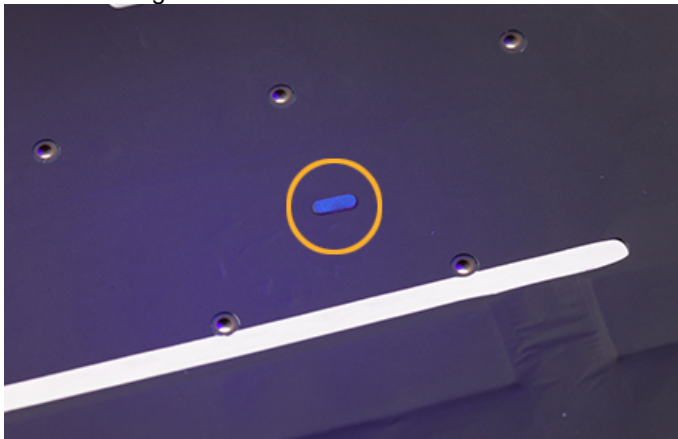
**Important:** A triggered LCI is not the only evidence of liquid contact. Be sure to inspect for corrosion or liquid residue during a quick check or repair.

### No Liquid Contact:

- LCI without UV light

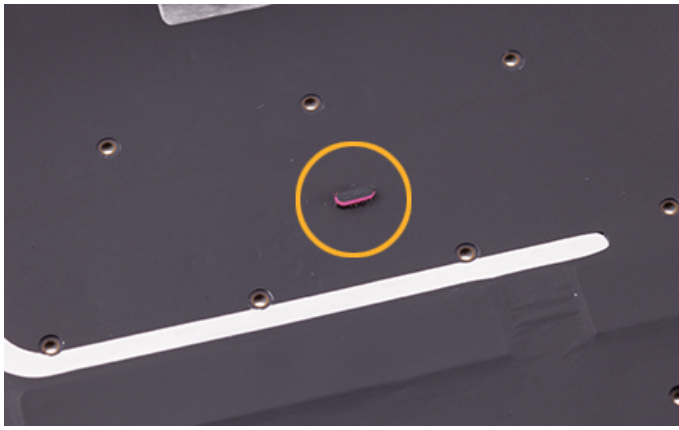


- LCI with UV light

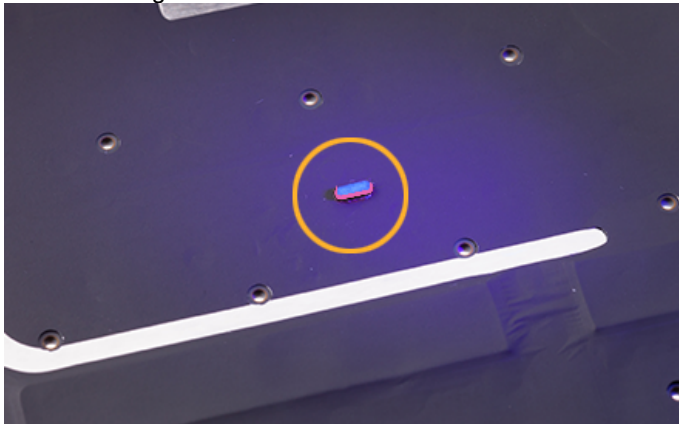


### Liquid Contact:

- LCI without UV light



- LCI with UV light



#### **Safety Information:**

**Caution:** UV LCIs illuminate with the use of the Apple-approved UV light (923-01604). Follow safety precautions when using this tool:

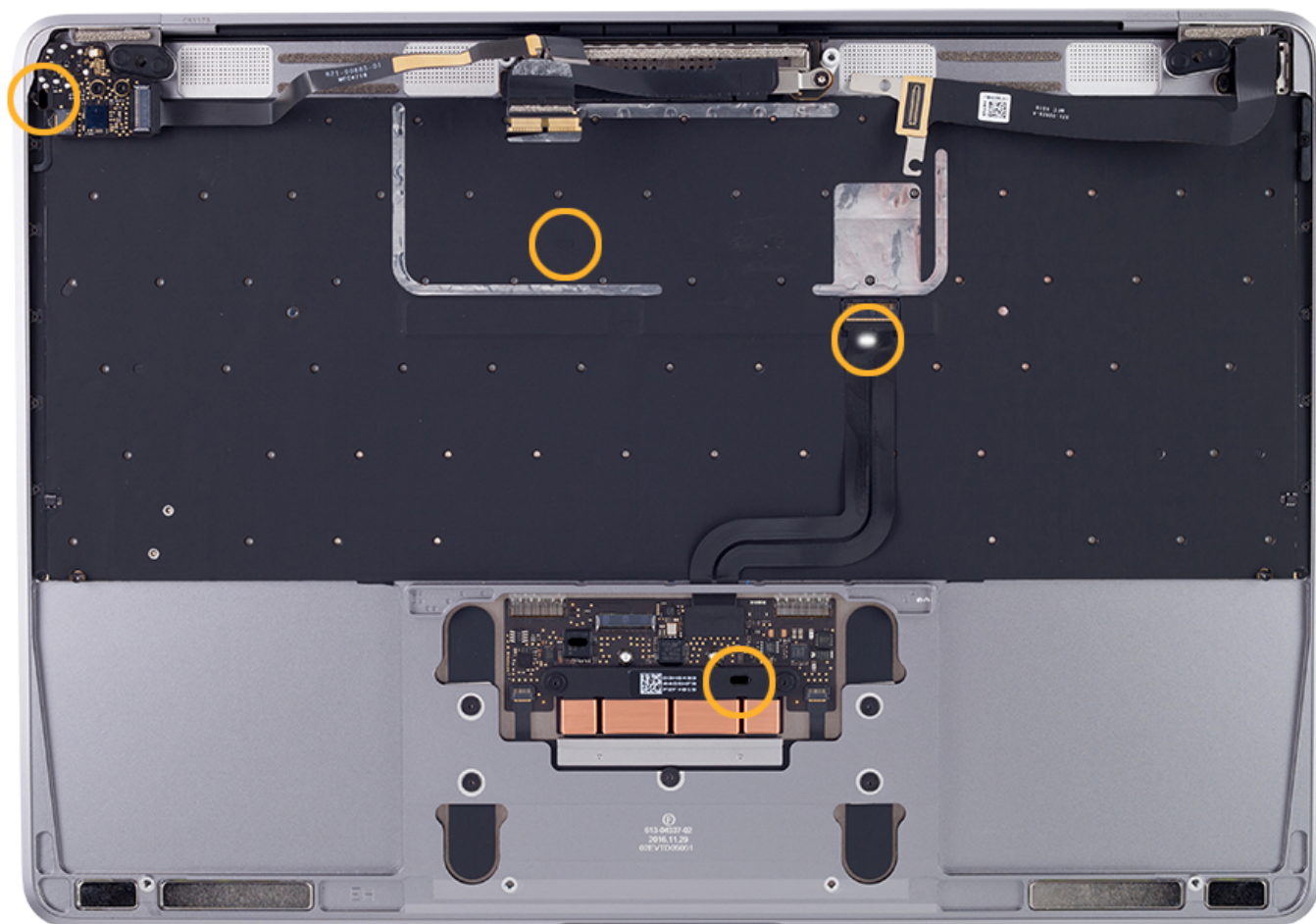
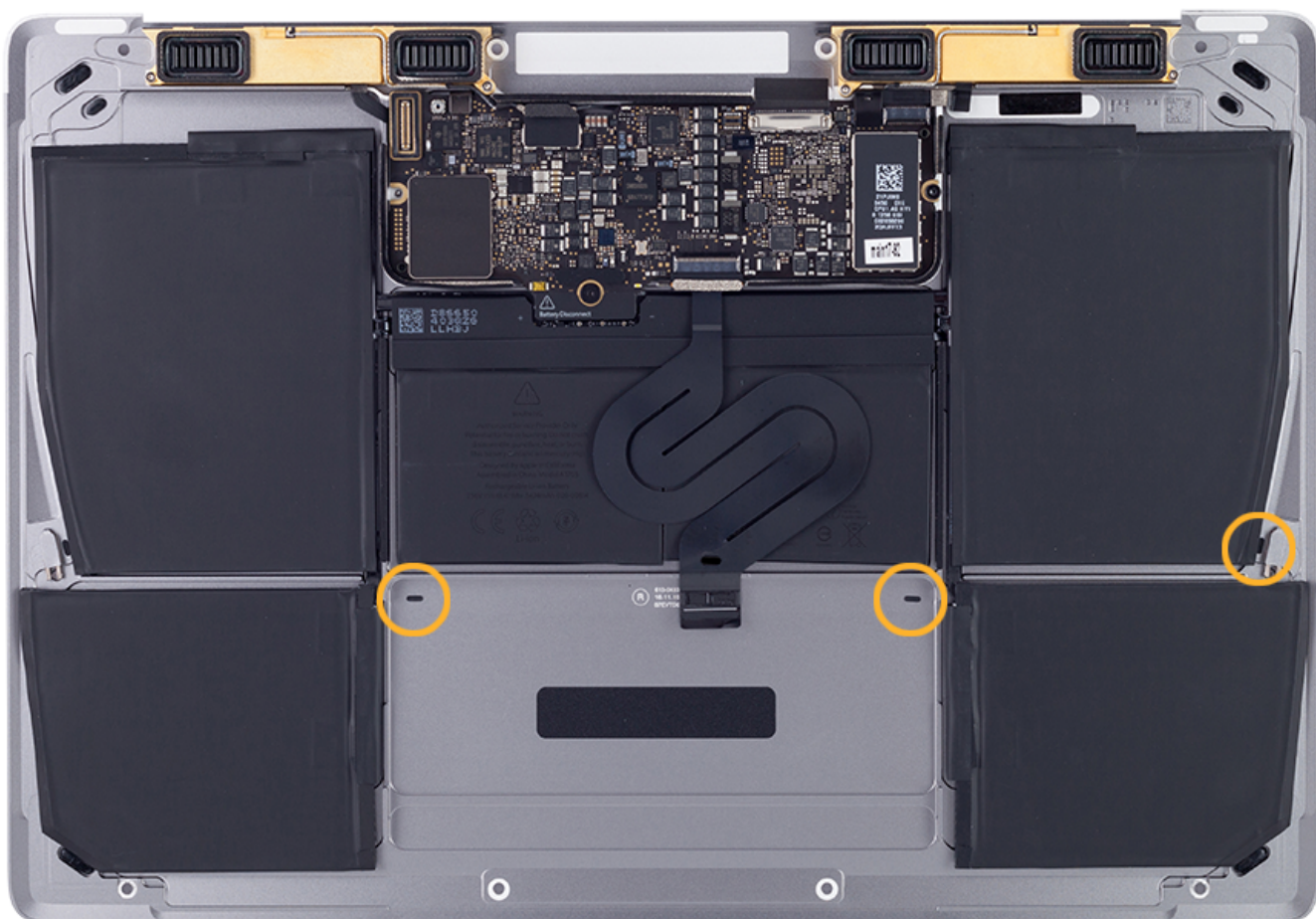
- Do not remove the warning labels on the UV light.



- Do not shine the UV light in anyone's eyes or face.
- Avoid repeated exposure to the UV light.
- If a different UV light is used, safety glasses and gloves must be worn to avoid excessive exposure.

The following images show the general location of LCIs in a MacBook computer.





## Procedure

### Note:

- Ultraviolet LCIs are black. The black LCIs blend in with the rest of the computer. When in contact with liquid, the LCIs may swell and become easier to identify.
- When using the UV light, hold it 12 to 14 inches (30 to 35 centimeters) from the computer and shine it at an angle of 15 to 75 degrees.



**Warning:** While the UV light is shining, do not hold it close to your face or bend your head down to look closely at the LCIs.



1. Press the power button on the UV light.



2. Check the color of the LCI. Blue indicates an LCI that has not been triggered. A pink LCI or a pink halo around the LCI indicates that it has been triggered. Refer to visual examples at the top of this article.

# LCD Pixel Anomalies

When displaying a single color over the screen area, the liquid crystal display (LCD) might show one or more pixels that are not properly lit.

LCD technology uses rows and columns of addressable points (pixels) that render text and images on the screen. Each pixel has three separate subpixels (red, green, and blue) that allow an image to render in full color. Each subpixel has a corresponding transistor responsible for turning the subpixel on and off.

Depending on the display size, there can be thousands or millions of subpixels on an LCD. For example, the LCD used in iMac (27-inch, Late 2013) has a display resolution of 2560 by 1440, which means there are 3.7 million pixels. Each pixel is made up of a red, a green, and a blue subpixel, resulting in over 11 million individual picture elements on the 27-inch display. Occasionally, a transistor may not work perfectly, resulting in the affected subpixel remaining off (dark) or on (bright). With the millions of subpixels on a display, it is possible to have a low number of such transistors on an LCD. In some cases, a small piece of dust or other foreign material may appear to be a pixel anomaly. Apple strives to use the highest-quality LCD displays in its products, but pixel anomalies can occur in a small percentage of them.

In some cases, pixel anomalies are caused by a piece of foreign material that is trapped inside the display or on the surface of the display or glass panel. Foreign material is typically irregular in shape and is usually most noticeable when viewed against a white background.

- For any computer, foreign material on the surface of the display or glass panel can easily be removed using a lint-free cloth.
- For any computer, foreign material trapped inside the display can only be resolved by replacing the entire display assembly.

# Common Troubleshooting Procedures for Mac Computers with Apple Silicon

**Caution:** Apple recommends that users [back up their data](#) before attempting any software troubleshooting. Essential files should be backed up before installing or reinstalling macOS. Apple is not responsible for any loss of data.

Before you begin troubleshooting, have the user attempt to reproduce the issue, then attempt to reproduce the issue yourself. Attempt the common troubleshooting procedures in the order listed in the table below.

Always refer to the troubleshooting procedures listed in the Service Guide of the Mac you're troubleshooting.

**Important:** The following steps may not be effective for all issues. Apply only the steps necessary to isolate and resolve the user's issue.



Procedure	Action
<b>Minimal Risk for Data Loss</b>	
<b>Charge Battery</b>	For Mac notebooks, connect to a known-good power outlet, using a known-good Apple Power Adapter and charge cable to charge the battery for at least 15 minutes. Note: Use the appropriate wattage power adapter.
<b>Log Out</b>	Simple issues may be resolved by logging out, then logging back in to the user account.  Deselect "Reopen windows when logging back in" to close the app windows that are currently open.
<b>Restart</b>	Restarting closes all open applications, turns off all hardware components, then restarts the Mac. A restart can quickly resolve a wide range of issues, including the following: <ul style="list-style-type: none"> <li>• Apps unexpectedly quit.</li> <li>• Battery life is shorter than expected.</li> <li>• Hardware is not performing as expected.</li> <li>• Interface or apps are slow to respond.</li> </ul>
<b>Shutdown (Reset)</b>	For notebooks with Apple silicon, turn off the Mac, then wait 15 seconds before you turn it back on.  For desktops with Apple silicon, turn off the Mac. Unplug the power cord for 15 seconds, then reconnect the power cord. Wait 5 seconds, then turn it back on.
<b>Safe Mode</b>	<a href="#">Start up in Safe Mode</a> (HT201262) to verify that the computer can startup completely without any issues.
<b>Update Software</b>	Check for and apply the latest software and firmware updates. Retest for the user's original issue before continuing with further troubleshooting.
<b>Check if in DFU mode</b>	Press and hold the power button for 10 seconds to attempt to shut down the computer. Then press the power button again to attempt to turn on the computer. If the computer turns on, then it was in DFU mode and has power.
<b>Greater Risk for Data Loss</b>	
<b>Repair Disk</b>	Start up to macOS Recovery and use <a href="#">Disk Utility</a> (HT210898) to attempt to repair a volume that may be exhibiting issues.
<b>Reinstall</b>	Use macOS Recovery to <a href="#">reinstall macOS</a> (HT204904) while preserving the data on the user volume.
<b>Revive</b>	In some circumstances, such as a power failure during a macOS upgrade, a Mac may become unresponsive and so the firmware must be revived. A Revive updates the firmware and macOS Recovery to the latest version. A Revive is designed to not make any changes to the startup volume, the user's data volume or any other volumes.  <a href="#">Apple Configurator 2 User Guide</a>
<b>Data Loss Will Occur</b>	
<b>Erase Disk</b>	If you can't access the startup volume, or user's data volume, and you've already attempted a revive using Apple Configurator 2, use Disk Utility in macOS Recovery to erase the startup volume, user's data volume, or any other volumes.
<b>Restore</b>	If the computer can't start up to either macOS or macOS Recovery, follow the Restore instructions in the <a href="#">Apple Configurator 2 User Guide</a> to restore the firmware and install the latest versions of macOS and macOS Recovery. When this process is complete, any data on any internal volumes is unrecoverable.



# Startup Options and macOS Recovery for Mac Computers with Apple Silicon

This article contains details about startup options and macOS Recovery for Mac computers with Apple silicon.

## Contents of this article:

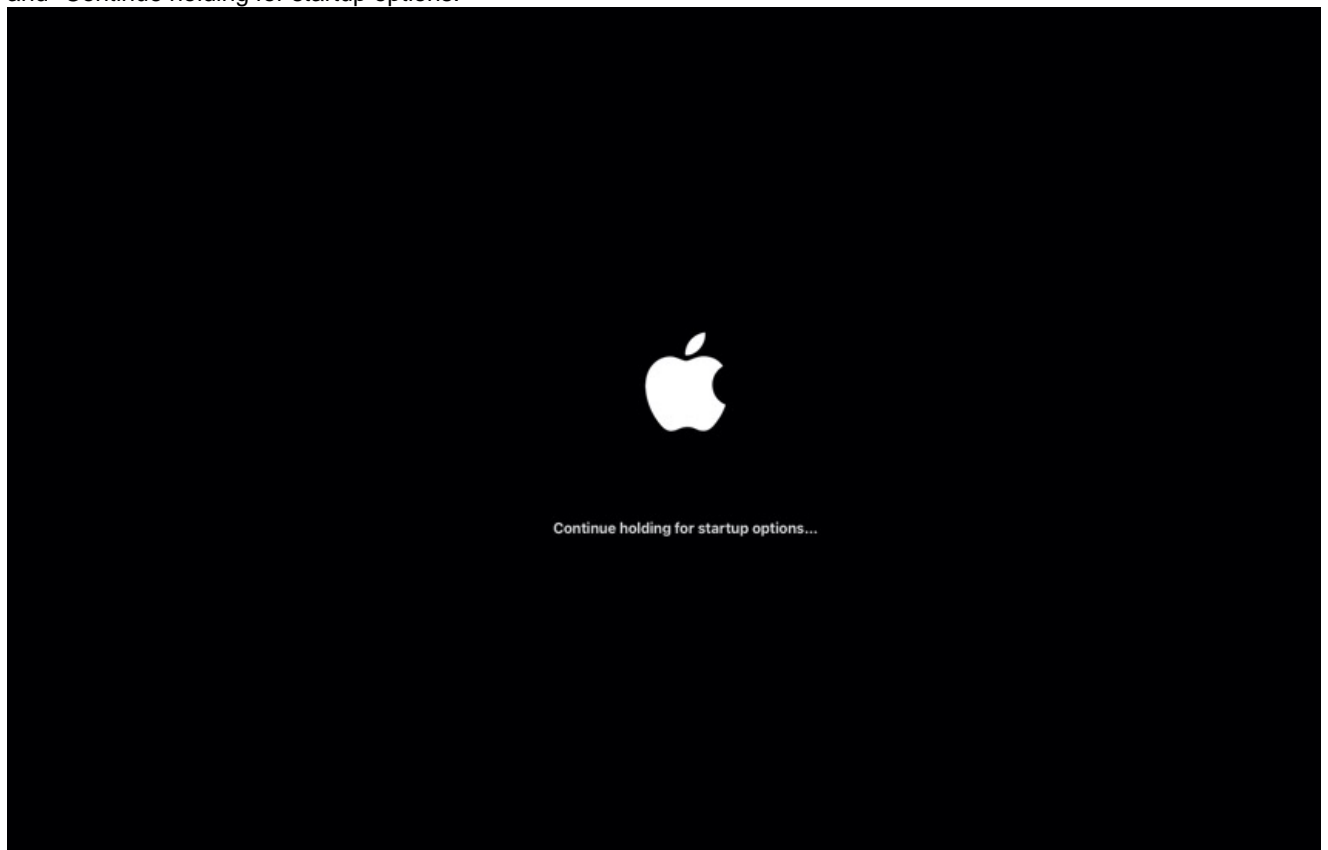
- [Startup Options](#)
- [Startup Disk](#)
- [Safe Mode](#)
- [macOS Recovery](#)
- [Diagnostics Mode](#)
- [Disk Sharing](#)

**Caution:** Apple recommends that users [back up their data](#) before attempting any software troubleshooting. Essential files should be backed up before installing or reinstalling macOS. Apple is not responsible for any loss of data.

## Startup Options

Startup options looks similar to Startup Manager on Intel-based Mac computers, but there are several differences. You can use startup options to do the following:

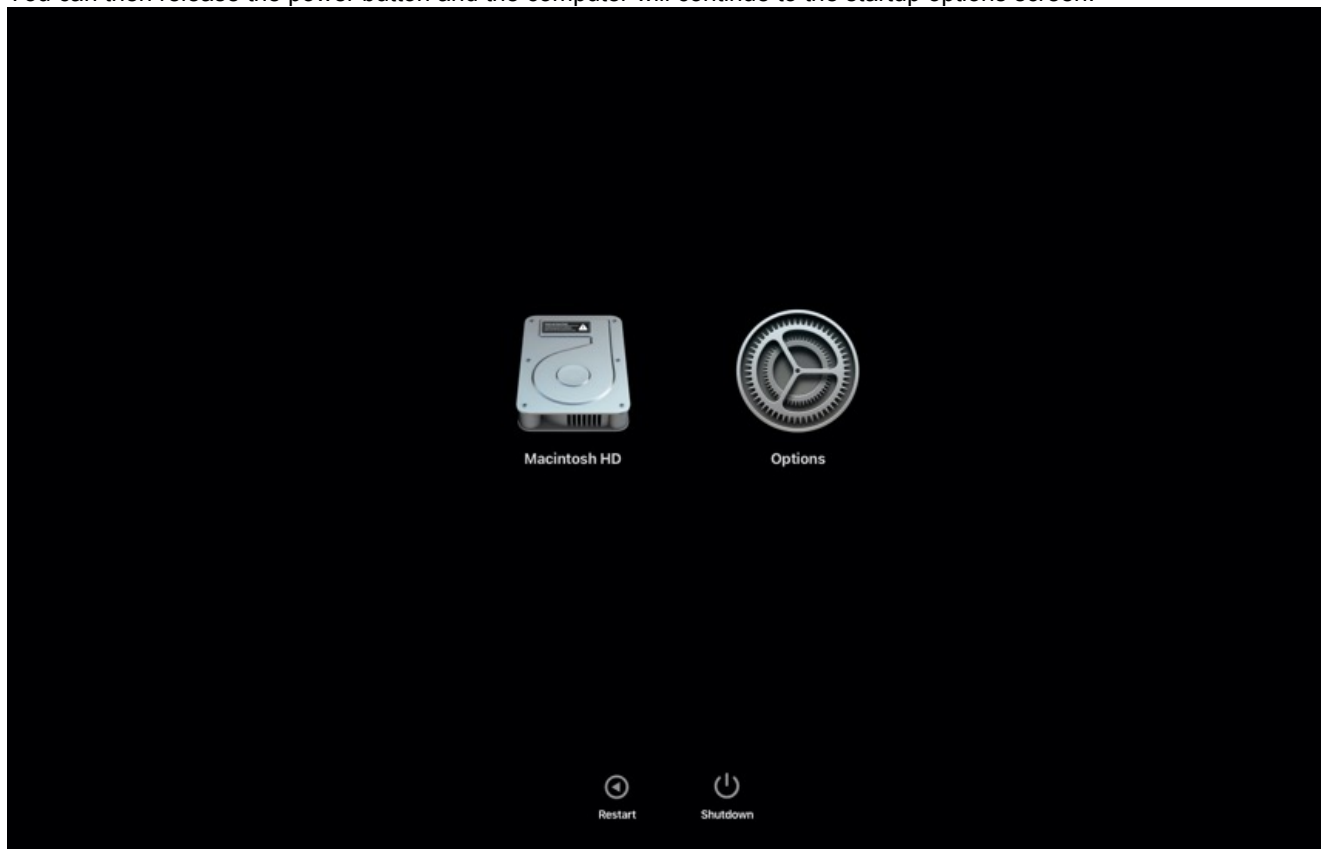
- Select a different startup disk
  - Start up in Safe Mode
  - Start up in macOS Recovery
  - Start diagnostics
1. On a Mac with Apple silicon, press and hold the power button. After 5 seconds, the Mac will display an Apple logo ( ) and "Continue holding for startup options."



2. Continue holding the power button. The Mac will display an Apple logo ( ) and "Loading startup options."



3. You can then release the power button and the computer will continue to the startup options screen.



## Startup Disk

- To choose a different startup disk, select the desired startup disk, then click "Continue."
- To set a default startup disk, select the desired startup disk, press the Option or Control key, then click "Always Use."
- Multiple versions of macOS can be installed.

## Safe Mode

- From startup options, select the startup disk, then hold Shift. Click "Continue in Safe Mode" to start up the Mac in [Safe Mode](#) (HT201262).

## macOS Recovery

- Choose the Options gear icon to start up in macOS Recovery.
- macOS Recovery is now a complete version of macOS, so features such as VoiceOver are fully supported.
- You'll always get the latest signed version of macOS.
- An internet connection is required to reinstall macOS.

## Diagnostics Mode

1. Press and hold the Command and D keys. After a few seconds, the screen will display "Continue holding to start diagnostics."



2. Continue holding the two keys until the computer starts up to Diagnostics mode.

## Disk Sharing

- Disk Sharing takes the place of Target Disk Mode, but significantly improves on security because a password is required every time a user wants to access their data on another computer.
- A Thunderbolt or USB-C cable is required.
- Big Sur is not required for the host Mac.

# MacBook Air (M1, 2020) Functional Overview

## Functional Overview for MacBook Air (M1, 2020)

Refer to this diagram for symptoms related to logic board connectors.



### 1 = Touch ID / Power Button flex

- Will not turn on from power button
- Will not authenticate using Touch ID

### 2 = Audio Board flex cable connector (connects between logic board and audio board, carries signals for audio port, Touch ID, and right sleep sensor)

- No external audio input
- No headphone audio output
- No headset controls or mic input
- No audio from right speaker
- Will not turn on from power button
- Will not authenticate using Touch ID
- No sleep when display closed
- No wake when display opened
- No video to internal display, but video to external display if one is connected (sensor stuck)

### 3 = eDP flex cable (also carries FaceTime HD camera & Ambient Light Sensor signals)

- No video, blurred, distorted, or monochrome video on display
- No display backlight
- Display does not dim in low light conditions
- Keyboard backlight cannot be enabled
- Camera does not function

### 4 = Wi-Fi + Bluetooth antenna connectors

- No/poor Wi-Fi reception
- Drops Wi-Fi connection
- Does not pair with Bluetooth devices
- Drops Bluetooth connection

### 5 = I/O Board (2 Apple Type-C ports) (USB-C)

- No power
- No power LED
- No battery charge
- Power adapter issues
- USB connectivity issues
- USB power issues
- No video to external display
- No audio to external display speakers
- Thunderbolt device not found
- Thunderbolt controller not recognized

- Thunderbolt driver issue
- Thunderbolt power issues

#### **6 = Left Speaker**

- No audio from left speaker
- Distorted audio from left speaker

#### **7 = Mic flex cable (carries signals for tri-mic and left sleep sensor)**

- No microphone audio input (with Internal Microphone selected in Sound Input Preferences)
- Distorted microphone audio input
- No sleep when display closed
- No wake when display opened
- No video to internal display, but video to external display if one is connected (sensor stuck)

#### **8 = Battery**

- No power
- Not charging (verify with correct model of power adapter)
- X symbol for battery in menu bar

#### **9 = IPD flex cable (carries signals for keyboard, keyboard backlight, and trackpad)**

- No Multi-Touch or cursor movement from built-in trackpad
- No click action from built-in trackpad
- No keyboard backlight
- Non-responsive keys

#### **10 = Right Speaker (also carries right sleep sensor signals)**

- No audio from right speaker
- Distorted audio from right speaker
- No sleep when display closed
- No wake when display opened
- No video to internal display, but video to external display if one is connected (sensor stuck)

#### **11 = Audio port**

- No external audio input
- No headphone audio output
- No headset controls or mic input

# Bluetooth or Wi-Fi Issues

## Unlikely causes:

**Likely Causes:** Logic board, vent/antenna module.

## Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none"><li>• Bluetooth service not available.</li><li>• Cannot turn Bluetooth on.</li><li>• Bluetooth can be turned on, but the computer is unable to pair with a known-good Bluetooth device.</li><li>• Intermittent loss of communication with paired Bluetooth device.</li><li>• Data transfer over Bluetooth times out or is too slow.</li></ul> <ul style="list-style-type: none"><li>• Wi-Fi service not available.</li><li>• Cannot turn Wi-Fi on.</li><li>• Wi-Fi can be turned on, but cannot connect to known-good Wi-Fi network.</li><li>• Intermittent loss of Wi-Fi communication.</li><li>• Poor Wi-Fi signal.</li></ul>	<p><b>For Bluetooth issues:</b></p> <ol style="list-style-type: none"><li>1. In System Preferences &gt; Bluetooth, verify that Bluetooth is on.</li><li>2. Attempt to pair the computer with a known-good Bluetooth keyboard, mouse, or trackpad.</li><li>3. Reset the Bluetooth device or delete the pairing (if applicable).</li></ol> <p><b>For Wi-Fi issues:</b></p> <ol style="list-style-type: none"><li>4. In System Preferences &gt; Network, verify that Wi-Fi is on.</li><li>5. Attempt to connect the computer to a known-good Wi-Fi network.</li><li>6. Create a new network location in System Preferences.</li></ol> <p><b>For Bluetooth or Wi-Fi issues:</b></p> <ol style="list-style-type: none"><li>7. If the customer is using a USB device, review <a href="#">HT201163: About USB on Mac computers</a> to identify possible interference with Wi-Fi and Bluetooth communications if the device is positioned near their antennas.</li><li>8. If the user's computer pairs Bluetooth devices correctly or connects to Wi-Fi correctly at your service location, research potential sources of interference in the user's environment, such as microwave ovens or cordless phones in the 2.4/5GHz range. Refer to <a href="#">HT201542: Resolve Wi-Fi and Bluetooth issues caused by wireless interference</a>.</li><li>9. Refer to <a href="#">HT202663: If your Mac doesn't connect to the Internet over Wi-Fi</a> to familiarize yourself with the macOS Wireless Diagnostic utility.</li><li>10. <b>Important:</b> Check for and apply the latest software and firmware updates to the user's computer. Retest for the user's original issue before continuing with further troubleshooting. To determine if the user's Mac needs updating, refer to <a href="#">HT201260: Find out which macOS your Mac is using</a>. To update macOS, refer to <a href="#">HT201541: How to update the software on your Mac</a>. You may need to connect to a wired network to complete all updates</li></ol> <p>If an update is available, perform the update on the user's computer and repeat this process until no further updates are available. Then retest for the user's original issue before continuing with further troubleshooting.</p> <ol style="list-style-type: none"><li>11. Refer to <a href="#">TP1907: Common Troubleshooting Procedures for Mac Computers with Apple Silicon</a> before performing further troubleshooting.</li></ol>

## Deep Dive

	Check	Result	Action	Code	Commodity
1.	<p>Run AST 2 Mac Resource Inspector diagnostic suite (MRI) on the user's computer.</p> <p>Examine diagnostic results to verify that the wireless module is listed.</p> <p>Is wireless module hardware detected?</p>	Yes	Go to step 2.	\${nodeText.yesSymptomCode}	
		No	<p>Replace the logic board and Touch ID board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	M99	MLB
2.	<p>Follow Service Guide procedures to remove the bottom case and disconnect the battery from the logic board.</p> <p>Locate the wireless antenna connectors on the logic board. Unplug and inspect the antenna cables and their connectors for any signs of pinched wires or connector damage.</p> <p>Do the antenna cables or connectors show signs of damage?</p>	Yes	<p>Replace the vent/antenna module.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	X03	OTHER ELECTRIC
		No	Go to step 3.	\${nodeText.noSymptomCode}	
3.	<p>With the antenna cables unplugged, inspect the wireless antenna cable connectors on the logic board for housing or pin damage.</p> <p>Do the antenna connectors on the logic board show signs of damage?</p>	Yes	<p>Replace the logic board and Touch ID board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	M24	MLB
		No	Go to step 4.	\${nodeText.noSymptomCode}	



	Check	Result	Action	Code	Commodity
4.	<p>Reseat the antenna cable connectors to the logic board, then retest for the Wi-Fi or Bluetooth issue.</p> <p>Is the issue resolved?</p>	Yes	Go to step 5.	\${nodeText.yesSymptomCode}	
		No	<p>Replace the logic board and Touch ID board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	M99	MLB
5.	<p>For Bluetooth, pair with a known-good Bluetooth device and verify that the connection is sustained for several minutes.</p> <p>For Wi-Fi, connect to a known-good wireless network and retest data throughput, checking for adequate transfer speeds.</p> <p>Verify that wireless connection is sustained for several minutes.</p> <p>Run AST 2 Post-Repair Diagnostic suite if available, to ensure no other issues remain.</p> <p>Is the issue resolved?</p>	Yes	The issue is resolved.	\${nodeText.yesSymptomCode}	
		No	<p><b>ESCALATION REQUIRED.</b></p> <p>Contact CSS for additional support or a multipart repair.</p>	\${nodeText.noSymptomCode}	

# Display Functional Issues

## Unlikely causes:

**Likely Causes:** eDP flex cable, display assembly.

## Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none"><li>• Distorted, blurred or illegible image on the display.</li><li>• Inconsistent clarity of image.</li><li>• Pixel anomalies.</li><li>• Vertical or horizontal lines.</li><li>• Vertical lines of nonuniform brightness repeating over the display.</li><li>• Image flickering or intermittent.</li><li>• Video “noise”.</li><li>• Incorrect or missing colors.</li><li>• Non-uniform color, contrast, or brightness.</li><li>• Image persistence or image sticking on screen.</li><li>• Light leakage around the display.</li><li>• Cannot change resolution on display.</li><li>• Display not illuminated.</li><li>• Display backlight not uniform.</li><li>• Display backlight fails after warm-up.</li><li>• Display backlight fails at certain brightness settings.</li></ul>	<p><b>Important:</b> Before performing any troubleshooting that requires disassembling the computer, ensure that you have installed the battery cover and disconnected the battery.</p> <p><b>Note:</b> This procedure is intended for display issues with the main display only. If the user has display issues with the Touch Bar display (on some models only), return to the list of symptoms and select “Touch Bar Issues”.</p> <ol style="list-style-type: none"><li>1. Thoroughly clean the display surface to remove any dust or debris. Examine the cleaned display and try to reproduce the issue.</li><li>2. Adjust the brightness to the maximum setting.</li><li>3. For issues of display quality, run all relevant display diagnostic suites from AST 2, such as Display Backlight and Color, Display Anomalies, and Image Persistence.</li><li>4. Refer to <a href="#">TP1138: Visual/Mechanical Inspection (VMI) Guide for Mac Displays</a>. If physical damage is found, return to the list of symptoms and select “Mechanical, Physical, Cosmetic, Battery, or Display Damage”.</li><li>5. For issues with pixel anomalies, refer to <a href="#">HT202025: About LCD display pixel anomalies for Apple products released in 2010 and later</a>.</li><li>6. For issues when using closed-display mode, refer to <a href="#">HT201834: Use your Mac notebook computer in closed-display mode with an external display</a>.</li><li>7. <b>Important:</b> Check for and apply the latest software and firmware updates to the user’s computer. Retest for the user’s original issue before continuing with further troubleshooting. To determine if the user’s Mac needs updating, refer to <a href="#">HT201260: Find out which macOS your Mac is using</a>. To update macOS, refer to <a href="#">HT201541: How to update the software on your Mac</a>.</li></ol> <p>If an update is available, perform the update on the user’s computer and repeat this process until no further updates are available. Then retest for the user’s original issue before continuing with further troubleshooting.</p> <ol style="list-style-type: none"><li>8. Refer to <a href="#">TP1907: Common Troubleshooting Procedures for Mac Computers with Apple Silicon</a> before performing further troubleshooting.</li></ol>

## Deep Dive

	Check	Result	Action	Code	Commodity
1.	Run AST 2 Mac Resource Inspector diagnostic suite (MRI). Review MRI results for information indicating internal display presence.	Yes	Go to step 2.	<code>\${nodeText.yesSymptomCode}</code>	
	Does MRI detect the display?	No	Go to step 3.	<code>\${nodeText.noSymptomCode}</code>	

	Check	Result	Action	Code	Commodity
2.	<p>While observing the issue, move the display assembly back and forth.</p> <p>Open and close the display fully several times to verify that the cables are not pinched or shorting.</p> <p>Does the symptom change with display movement?</p>	Yes	Go to step 3.	\${nodeText.yesSymptomCode}	
		No	Go to step 6.	\${nodeText.noSymptomCode}	
3.	<p>Follow Service Guide procedures to remove the bottom case and disconnect the battery from the logic board.</p> <p>Disconnect and inspect the eDP flex cable and its connectors, looking for connector or cable damage.</p> <p>Also check for damage on the display and logic board flex connectors.</p> <p>Did you find damage to this flex cable or any connectors?</p>	Yes	Go to step 4.	\${nodeText.yesSymptomCode}	
		No	Go to step 5.	\${nodeText.noSymptomCode}	
4.	<p>Determine whether the damage is located on the flex cable, or other parts.</p> <p>Is the damage limited to the flex cable?</p>	Yes	<p>Replace the eDP flex cable.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	X03	INTERNAL CABLE
		No	<p><b>ESCALATION REQUIRED.</b></p> <p>Contact CSS for additional support or a multipart repair.</p>	\${nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
5.	<p>Reseat the eDP flex cable connectors on the logic board and display. Reseating the cable can restore normal video.</p> <p>Reassemble the computer and retest the internal display.</p> <p>Is normal video restored?</p>	Yes	<p>The issue was resolved by reseating the eDP flex cable.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	<p> <code>           \${nodeText.yesSymptomCode}         </code> </p>	
		No	Go to step 6.	<p> <code>           \${nodeText.noSymptomCode}         </code> </p>	
6.	<p>Connect a known-good compatible external display to the user's computer.</p> <p>Check for an image on the connected external display.</p> <p>Is an image clearly visible on the connected external display?</p>	Yes	<p>Replace the display assembly.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	L03	LCD
		No	<p>Replace the logic board and Touch ID board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	M03	MLB

	Check	Result	Action	Code	Commodity
7.	Restart the computer and verify the image on the internal display, backlight, camera, and ambient light sensor are functioning normally.  Run AST 2 Post-Repair Diagnostic suite if available, to ensure no other issues remain.  Is the issue resolved?	Yes	The issue is resolved.	\${nodeText.yesSymptomCode}	
		No	<b>ESCALATION REQUIRED.</b>  Contact CSS for additional support or a multipart repair.	\${nodeText.noSymptomCode}	

# Camera Issues

## Unlikely causes:

**Likely Causes:** eDP flex cable, display assembly.

## Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none"><li>• Camera does not function.</li><li>• No camera indicator light.</li><li>• Excessive blooming in camera image.</li><li>• Poor white balance.</li><li>• Poor focus.</li><li>• Distorted or discolored image.</li><li>• Camera fails to respond to changing ambient light conditions.</li></ul>	<p><b>Important:</b> Before performing any troubleshooting that requires disassembling the computer, ensure that you have installed the battery cover and disconnected the battery.</p> <ol style="list-style-type: none"><li>1. Verify camera lens is clear of contaminants.</li><li>2. Ask user about lighting conditions in working environment. Dim lighting causes poor image quality. Overly bright lighting can bounce off surfaces onto subject and make image foggy.</li><li>3. Striped, textured, and mesh clothing can create moiré patterns in image.</li><li>4. Disconnect all peripheral devices and restart computer.</li><li>5. Important: Check for and apply the latest software and firmware updates to the user's computer. Retest for the user's original issue before continuing with further troubleshooting. To determine if the user's Mac needs updating, refer to <a href="#">HT201260: Find out which macOS your Mac is using</a>. To update macOS, refer to <a href="#">HT201541: How to update the software on your Mac</a>.</li></ol> <p>If an update is available, perform the update on the user's computer and repeat this process until no further updates are available. Then retest for the user's original issue before continuing with further troubleshooting.</p> <ol style="list-style-type: none"><li>6. Refer to <a href="#">TP1907: Common Troubleshooting Procedures for Mac Computers with Apple Silicon</a> before performing further troubleshooting.</li></ol>

## Deep Dive

	Check	Result	Action	Code	Commodity
1.	Run AST 2 Mac Resource Inspector diagnostic suite (MRI). Review MRI results for information indicating camera presence.	Yes	Go to step 2.	<code>\${nodeText.yesSymptomCode}</code>	
	Does MRI detect camera?	No	Go to step 3.	<code>\${nodeText.noSymptomCode}</code>	
2.	Open Photo Booth. Verify indicator light next to camera lights up. Verify that the image looks normal.	Yes	The issue cannot be duplicated.	<code>\${nodeText.yesSymptomCode}</code>	
	Does camera indicator light up and does image appear normal?	No	Go to step 3.	<code>\${nodeText.noSymptomCode}</code>	

	Check	Result	Action	Code	Commodity
3.	<p>Follow Service Guide procedures to remove the bottom case and disconnect the battery from the logic board.</p> <p>Disconnect and inspect the eDP flex cable and its connectors, looking for connector or cable damage.</p> <p>Also check for damage on the display and logic board flex connectors.</p> <p>Did you find damage to this flex cable or any connectors?</p>	Yes	Go to step 4.	\${nodeText.yesSymptomCode}	
		No	Go to step 5.	\${nodeText.noSymptomCode}	
4.	<p>Determine whether the damage is located on the flex cable, or other parts.</p> <p>Is the damage limited to the flex cable?</p>	Yes	<p>Replace the eDP flex cable.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	X03	INTERNAL CABLE
		No	<p><b>ESCALATION REQUIRED.</b></p> <p>Contact CSS for additional support or a multipart repair.</p>	\${nodeText.noSymptomCode}	



	Check	Result	Action	Code	Commodity
5.	Reseat the eDP flex cable connectors on the logic board and display. Reseating the cable can restore camera functionality.	Yes	<p>The issue was resolved by reseating the eDP flex cable.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	<p> <code>\${nodeText.yesSymptomCode}</code> </p>	
	<p>Reassemble the computer and retest for camera functionality.</p> <p>Is camera functionality restored?</p>	No	<p>Replace the display assembly.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	<p>L17</p>	LCD
6.	Verify that camera now functions as expected and that image quality is normal.	Yes	<p>The issue is resolved.</p>	<p> <code>\${nodeText.yesSymptomCode}</code> </p>	
	<p>Run AST 2 Post-Repair Diagnostic suite if available, to ensure no other issues remain.</p> <p>Is the issue resolved?</p>	No	<p><b>ESCALATION REQUIRED.</b></p> <p>Contact CSS for additional support or a multipart repair.</p>	<p> <code>\${nodeText.noSymptomCode}</code> </p>	

# Keyboard Functional Issues

## Unlikely causes:

**Likely Causes:** Top case assembly, keycaps.

## Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none"><li>• Letters or characters repeat unexpectedly.</li><li>• Letters or characters do not appear.</li><li>• One or more keys feel “sticky” or do not respond in a consistent manner.</li><li>• One or more keys feel stuck in down or up position.</li><li>• One or more keys makes abnormal noise when pressed.</li><li>• One or more keys makes a metallic click sound.</li><li>• Key press feels uneven or stiff.</li><li>• Key not responding, spongy, or not going all the way down.</li><li>• Delayed key return.</li><li>• Keycaps or key switch mechanisms broken or missing.</li><li>• Keystrokes are not recognized.</li><li>• Keyboard locks up.</li><li>• Displayed characters do not match the keys pressed.</li></ul>	<p><b>Important:</b> Before performing any troubleshooting that requires disassembling the computer, ensure that you have installed the battery cover and disconnected the battery.</p> <p><b>Note:</b> Initial keyboard troubleshooting does not involve opening the computer case.</p> <ol style="list-style-type: none"><li>1. Press Caps Lock key to see if LED lights up, indicating at least a partial connection to logic board. Be aware that pressing the Caps Lock key on Apple keyboards may not immediately activate the Caps Lock function. The key must be held down slightly longer in order to activate the Caps Lock function. This is to prevent accidental activation of Caps Lock mode. This is normal behavior and does not indicate a service issue.</li><li>2. In System Preferences &gt; Keyboard &gt; Input Sources, enable Show Input menu in menu bar. From Input menu in the menu bar, select Show Keyboard Viewer. Check if keystrokes on keyboard are recognized in Keyboard Viewer. If built-in keyboard is not functioning, use an external USB keyboard to perform this step.</li><li>3. Confirm that correct keyboard layout is selected in System Preferences &gt; Keyboard &gt; Input Sources. Ensure that any keyboard accessibility features have been disabled by checking System Preferences &gt; Accessibility &gt; General and System Preferences &gt; Accessibility &gt; Keyboard.</li><li>4. Open System Preferences &gt; Accessibility &gt; Mouse &amp; Trackpad. Verify that Mouse Keys is Off. With Mouse Keys on you can use the keyboard or the numeric keypad keys to move the mouse, however normal keyboard functionality will be disabled until the Mouse Keys feature is turned off. Refer to <a href="#">HT203162: One or more keys on the keyboard do not respond</a> for more information.</li><li>5. If a Bluetooth keyboard is present and paired with the unit, it may be overriding input commands from the built-in keyboard. Turn off Bluetooth temporarily to isolate the issue to the built-in keyboard.</li><li>6. <b>Important:</b> Check for and apply the latest software and firmware updates to the user's computer. Retest for the user's original issue before continuing with further troubleshooting. To determine if the user's Mac needs updating, refer to <a href="#">HT201260: Find out which macOS your Mac is using</a>. To update macOS, refer to <a href="#">HT201541: How to update the software on your Mac</a>.</li></ol> <p>If an update is available, perform the update on the user's computer and repeat this process until no further updates are available. Then retest for the user's original issue before continuing with further troubleshooting.</p> <ol style="list-style-type: none"><li>7. Refer to <a href="#">TP1907: Common Troubleshooting Procedures for Mac Computers with Apple Silicon</a> before performing further troubleshooting.</li></ol>

## Deep Dive

	Check	Result	Action	Code	Commodity
1.	Check the keyboard and keycaps for damage by referring to <a href="#">TP1151: Visual/Mechanical Inspection (VMI) Guide for Mac Computers - Table of Contents</a> .  Are there any damaged keycaps?	Yes	Go to step 2.	\${nodeText.yesSymptomCode}	
		No	Go to step 4.	\${nodeText.noSymptomCode}	
2.	Refer to <a href="#">TP1816: Keycap Replacement</a> . This procedure describes how to remove the affected keycaps. The procedure also lists all keycap kit part numbers for this model.  <b>Important:</b> Before removing any keycaps, verify that the correct keycap kit is available. Any removed keycaps must be replaced by new keycaps. Do not reuse keycaps.  If the correct keycap kit is not available, reply 'NO' to order the keycap kit.  Is the correct keycap kit available?	Yes	Go to step 3.	\${nodeText.yesSymptomCode}	
		No	Order the correct keycap kit for this model.  Return to this procedure when the kit is available.	K27	PIECE PART

	Check	Result	Action	Code	Commodity
3.	<p>1. Refer to <a href="#">TP1816: Keycap Replacement</a> to remove and replace the affected keycap. A keycap should always be replaced each time it is removed, even for inspection or cleaning.</p> <p>While the keycap is removed, perform the following steps:</p> <p>A. Clean the inner aluminum part of the keycap well to remove any liquid residue that may be present.</p> <p>B. Inspect the scissor mechanism to verify it is functional and has no damaged pins or any other damage. Scissors can also be replaced if damaged.</p> <p>C. Inspect the rubber dome for damage. Keycaps and scissor mechanisms can be replaced, but the rubber dome cannot. A damaged rubber dome requires replacement of the entire top case.</p> <p>2. Refer to <a href="#">TP1816: Keycap Replacement</a> to replace the keycap or replace the scissor mechanism if damaged. Do not reuse keycaps.</p> <p>3. Retest the keyboard to verify that all keyboard keys function normally, and the affected keycap or keycaps no longer exhibit this specific symptom.</p>	Yes	Issue resolved by replacing keycaps.	<code>\${nodeText.yesSymptomCode}</code>	KEYBOARD
	Did this resolve the issue?	No	<p>Replace the top case assembly.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	K27	
4.	<p>A liquid spill can short key signals and stop keyboard operations. Visual inspection indicating liquid spills should be very obvious to you and to user.</p> <p><b>Note:</b> Inform user that computer failures due to accidental damage are not covered, and if applicable, discuss out-of-warranty repair options. Refer to <a href="#">OP14: Determining and quoting accidental damage for Mac portables</a>.</p> <p>Is it obvious that keyboard keys were exposed to a liquid spill?</p>	Yes	Go to step 5.	<code>\${nodeText.yesSymptomCode}</code>	
		No	Go to step 6.	<code>\${nodeText.noSymptomCode}</code>	

	Check	Result	Action	Code	Commodity
5.	<p>Determine whether liquid damage is limited to the top case or whether multiple parts are damaged.</p> <p>Is there liquid damage to multiple parts?</p>	Yes	<p><b>ESCALATION REQUIRED.</b></p> <p>Contact CSS for additional support or for a multipart repair related to liquid spill observation found during repair.</p>	\${nodeText.yesSymptomCode}	
		No	<p>Replace the top case assembly.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	K90	KEYBOARD
6.	<p>Run the AST 2 Keyboard diagnostic suite to verify that all keys are functional, including modifier keys.</p> <p><b>Note:</b> Diagnostics only verify keyboard electrical operation. Diagnostics do not verify keyboard mechanical feel and response.</p> <p>If you have verified a mechanical issue with the user's keyboard and diagnostic tests pass, reply "Yes."</p> <p>Does the keyboard pass testing?</p>	Yes	Go to step 7.	\${nodeText.yesSymptomCode}	
		No	Go to step 10.	\${nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
7.	<p>Refer to <a href="#">HT205662: How to clean the keyboard of your MacBook or MacBook Pro</a> to carefully apply compressed air to clean the keyboard.</p> <p>Use compressed air and spray around the affected key, in the space between the top case and the keycap.</p> <p>Retest the keyboard to verify that all keyboard keys function normally, and the affected keycap or keycaps no longer exhibit this specific symptom.</p> <p>Did this resolve the issue?</p>	Yes	Issue resolved by cleaning.	\${nodeText.yesSymptomCode}	
		No	Go to step 8.	\${nodeText.noSymptomCode}	
8.	<p>Refer to <a href="#">TP1816: Keycap Replacement</a>. This procedure describes how to remove the affected keycaps. The procedure also lists all keycap kit part numbers for this model.</p> <p><b>Important:</b> Before removing any keycaps, verify that the correct keycap kit is available. Any removed keycaps must be replaced by new keycaps. Do not reuse keycaps.</p> <p>If the correct keycap kit is not available, reply 'NO' to order the keycap kit.</p> <p>Is the correct keycap kit available?</p>	Yes	Go to step 9.	\${nodeText.yesSymptomCode}	
		No	<p>Order the correct keycap kit for this model.</p> <p>Return to this procedure when the kit is available.</p>	K99	PIECE PART

	Check	Result	Action	Code	Commodity
9.	1. If cleaning the keyboard did not resolve the issue, then refer to <a href="#">TP1816: Keycap Replacement</a> to remove and replace the affected keycap. A keycap should always be replaced each time it is removed, even for inspection or cleaning.	Yes	Issue resolved by cleaning.	<code>\${nodeText.yesSymptomCode}</code>	KEYBOARD
	While the keycap is removed, perform the following steps:  A. Clean the inner aluminum part of the keycap well to remove any liquid residue that may be present. B. Inspect the scissor mechanism to verify it is functional and has no damaged pins or any other damage. Scissors can also be replaced if damaged. C. Inspect the rubber dome for damage. Keycaps and scissor mechanisms can be replaced, but the rubber dome cannot. A damaged rubber dome requires replacement of the entire top case.	No	Replace the top case assembly.  Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.	K99	
	2. Refer to <a href="#">TP1816: Keycap Replacement</a> to replace the keycap or replace the scissor mechanism if damaged. Do not reuse keycaps. 3. Retest the keyboard to verify that all keyboard keys function normally, and the affected keycap or keycaps no longer exhibit this specific symptom.		Verify that the issue is resolved.		
	Did this resolve the issue?				
10.	Follow Service Guide procedures to remove the bottom case and disconnect the battery from the logic board.	Yes	Go to step 12.	<code>\${nodeText.yesSymptomCode}</code>	
	Locate the keyboard or IPD flex cable connector (depending on model) on logic board and verify that this flex cable is present and connected.	No	Go to step 11.	<code>\${nodeText.noSymptomCode}</code>	
	Is this flex cable present?				



	Check	Result	Action	Code	Commodity
11.	If keyboard or IPD flex cable is missing, it may be under logic board. Remove logic board to locate the flex cable.	Yes	Issue resolved by reseating keyboard or IPD flex cable.	\${nodeText.yesSymptomCode}	
	Reseat cable firmly to logic board. Reassemble computer.	No	Go to step 12.	\${nodeText.noSymptomCode}	
	Run the AST 2 Keyboard diagnostic suite to verify that all keys are functional after repair, including modifier keys.				
	Is keyboard now functioning?				
12.	Follow Service Guide procedures to remove the bottom case and disconnect the battery from the logic board.	Yes	Go to step 14.	\${nodeText.yesSymptomCode}	
	Disconnect and inspect the keyboard or IPD flex cable and its connectors, looking for connector or cable damage.	No	Go to step 13.	\${nodeText.noSymptomCode}	
	Also check for damage on the trackpad, keyboard, and logic board flex connectors.				
	Did you find damage to this flex cable or any connectors?				
13.	With flex cable reseated to logic board connector, reassemble computer.  Run the AST 2 Keyboard diagnostic suite to verify that all keys are functional after repair, including modifier keys.  Is keyboard now functioning?	Yes	Issue resolved by reseating keyboard or IPD flex cable.	\${nodeText.yesSymptomCode}	
		No	Replace the top case assembly.	K11	KEYBOARD
			Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.  Verify that the issue is resolved.		

	Check	Result	Action	Code	Commodity
14.	<p>Determine whether the damage is located on the flex cable, or other parts.</p> <p>Is there damage to multiple parts?</p>	Yes	<p><b>ESCALATION REQUIRED.</b></p> <p>Contact CSS for additional support or a multipart repair.</p>	\${nodeText.yesSymptomCode}	
		No	<p>Replace the keyboard flex cable or IPD flex cable (depending on model).</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	X03	INTERNAL CABLE
15.	<p>Restart the computer and verify that the keyboard is functioning normally.</p> <p>Run AST 2 Post-Repair Diagnostic suite if available, to ensure no other issues remain.</p> <p>Is the issue resolved?</p>	Yes	The issue is resolved.	\${nodeText.yesSymptomCode}	
		No	<p><b>ESCALATION REQUIRED.</b></p> <p>Contact CSS for additional support or a multipart repair.</p>	\${nodeText.noSymptomCode}	

# Keyboard Backlight Issues

## Unlikely causes:

**Likely Causes:** Top case assembly.

## Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none"><li>Keyboard operation is normal except for backlight.</li><li>Keyboard backlight is not detected in a darkened room.</li><li>Keyboard backlight is uneven: some keys are dim or one or more keys are brighter than the other.</li><li>Part of keyboard is not backlit.</li></ul>	<p><b>Important:</b> Before performing any troubleshooting that requires disassembling the computer, ensure that you have installed the battery cover and disconnected the battery.</p> <p><b>Note:</b> This procedure is intended for backlight issues with the keyboard only. If the user has backlight issues with the Touch Bar display (on some models only), return to the list of symptoms and select “Touch Bar Issues”.</p> <ol style="list-style-type: none"><li>Check System Preferences &gt; Keyboard to see whether the “Adjust keyboard brightness in low light” option is available and checked. Refer to <a href="#">HT202310: Adjust the brightness of your backlit keyboard</a>.</li><li>The keyboard backlight is enabled only when the ambient light sensor (ALS) detects low light conditions. Check System Preferences &gt; Displays to see whether the “Automatically adjust brightness” option is selected.</li><li>Check ALS functionality by covering the sensor (located on the display assembly near the camera) with your hand to simulate a dark room. Check whether the keyboard backlight brightness increases.</li><li>Keep the ALS covered and use controls to increase the keyboard backlight level.</li><li><b>Important:</b> Check for and apply the latest software and firmware updates to the user’s computer. Retest for the user’s original issue before continuing with further troubleshooting. To determine if the user’s Mac needs updating, refer to <a href="#">HT201260: Find out which macOS your Mac is using</a>. To update macOS, refer to <a href="#">HT201541: How to update the software on your Mac</a>.</li></ol> <p>If an update is available, perform the update on the user’s computer and repeat this process until no further updates are available. Then retest for the user’s original issue before continuing with further troubleshooting.</p> <ol style="list-style-type: none"><li>Refer to <a href="#">TP1907: Common Troubleshooting Procedures for Mac Computers with Apple Silicon</a> before performing further troubleshooting.</li></ol>

## Deep Dive

	Check	Result	Action	Code	Commodity
1.	In AST 2, run the Keyboard test suite and verify that the keyboard backlight illuminates at the appropriate part of the test.	Yes	The issue cannot be duplicated.	<code>#{nodeText.yesSymptomCode}</code>	
	Does the keyboard backlight pass testing?	No	Go to step 2.	<code>#{nodeText.noSymptomCode}</code>	

	Check	Result	Action	Code	Commodity
2.	Keyboard backlight flex cables connect from the top case to the logic board. Each cable drives part of the keyboard backlight (left or right side), and on some models, power to both sides is supplied by a third cable.  Follow Service Guide procedures to locate all keyboard backlight flex cable connectors on the logic board and verify all cables are present and connected.  Are all flex cables present?	Yes	Go to step 4.	\${nodeText.yesSymptomCode}	
		No	Go to step 3.	\${nodeText.noSymptomCode}	
3.	If a keyboard backlight flex cable is missing, it may be under logic board. Remove logic board to locate keyboard backlight flex cable.  Reseat cable firmly to logic board. Reassemble computer. Adjust keyboard backlight using controls. Cover ALS to activate keyboard backlight in a well lit area.  Is keyboard backlight functioning?	Yes	Issue resolved by reseating keyboard backlight flex cable. Verify resolution.	\${nodeText.yesSymptomCode}	
		No	Go to step 4.	\${nodeText.noSymptomCode}	
4.	Disconnect and inspect all keyboard backlight flex cables and their connectors on the logic board.  Check for damage on the flex cables and the logic board connectors.  Is there damage to any keyboard backlight flex cable or any connectors?	Yes	Go to step 6.	\${nodeText.yesSymptomCode}	
		No	Go to step 5.	\${nodeText.noSymptomCode}	
5.	With all keyboard backlight flex cables reseated to logic board connectors, reassemble computer.  Retest in low light conditions to activate keyboard backlight. Adjust keyboard backlight using controls.  Is keyboard backlight functioning?	Yes	Issue resolved by reseating keyboard backlight flex cables. Verify resolution.	\${nodeText.yesSymptomCode}	
		No	Replace the top case assembly.  Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.  Verify that the issue is resolved.	K10	KEYBOARD

	Check	Result	Action	Code	Commodity
6.	<p>Determine whether damage is limited to any keyboard backlight flex cable (part of the top case), or whether multiple parts are damaged.</p> <p>Is there damage to multiple parts?</p>	Yes	<p><b>ESCALATION REQUIRED.</b></p> <p>Contact CSS for additional support or a multipart repair.</p>	\${nodeText.yesSymptomCode}	
		No	<p>Replace the top case assembly.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	K16	KEYBOARD
7.	<p>Restart the computer and verify that the keyboard backlight is functioning normally.</p> <p>Run AST 2 Post-Repair Diagnostic suite if available, to ensure no other issues remain.</p> <p>Is the issue resolved?</p>	Yes	The issue is resolved.	\${nodeText.yesSymptomCode}	
		No	<p><b>ESCALATION REQUIRED.</b></p> <p>Contact CSS for additional support or a multipart repair.</p>	\${nodeText.noSymptomCode}	

# Microphone Issues

## Unlikely causes:

**Likely Causes:** Audio board, top case assembly.

## Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none"><li>Microphone not working, but audio output is functional.</li><li>Microphone audio is garbled.</li><li>Internal microphone input cannot be selected.</li></ul>	<p><b>Important:</b> Before performing any troubleshooting that requires disassembling the computer, ensure that you have installed the battery cover and disconnected the battery.</p> <ol style="list-style-type: none"><li>Go to System Preferences &gt; Sound, and verify the following:  Input tab:<ul style="list-style-type: none"><li>Internal Microphone is available and selected for sound input.</li><li>“Input volume” slider is not set to zero.</li></ul> Output tab:<ul style="list-style-type: none"><li>Internal Speakers is available and selected for sound output.</li><li>“Output volume” is not muted or set to zero.</li></ul></li><li>Go to System Preferences &gt; Sound &gt; Input tab, and verify that the “Input level” indicator moves when speaking into the microphone.</li><li>Check that no cables are inserted into the headphone jack. Use an otoscope to visually inspect jack. Use compressed air to clean and remove any debris.</li><li>Disconnect all peripheral devices and restart computer.</li><li><b>Important:</b> Check for and apply the latest software and firmware updates to the user’s computer. Retest for the user’s original issue before continuing with further troubleshooting. To determine if the user’s Mac needs updating, refer to <a href="#">HT201260: Find out which macOS your Mac is using</a>. To update macOS, refer to <a href="#">HT201541: How to update the software on your Mac</a>. If an update is available, perform the update on the user’s computer and repeat this process until no further updates are available. Then retest for the user’s original issue before continuing with further troubleshooting.</li><li>Refer to <a href="#">TP1907: Common Troubleshooting Procedures for Mac Computers with Apple Silicon</a> before performing further troubleshooting.</li></ol>

## Deep Dive

	Check	Result	Action	Code	Commodity
1.	Run AST 2 Audio Test suite to verify that built-in microphone detects expected audio test patterns produced from each speaker.	Yes	The issue cannot be duplicated.	<code>#{nodeText.yesSymptomCode}</code>	
	Does the computer pass AST 2 Audio Test suite?	No	Go to step 2.	<code>#{nodeText.noSymptomCode}</code>	

	Check	Result	Action	Code	Commodity
2.	Disconnect any connected headphones or external speakers. Go to System Preferences > Sound > Input tab and verify that Internal Microphone is available and selected for sound input.  Does System Preferences list "External Microphone" instead?	Yes	Go to step 3.	#{nodeText.yesSymptomCode}	
		No	Go to step 4.	#{nodeText.noSymptomCode}	
3.	Debris in, or damage to, the headphone jack can cause the computer to become stuck in External Microphone input mode.  Use a lighted otoscope or magnifying glass to inspect for damage or debris inside the jack.  Use compressed air to clean and remove any debris.  Is there any damage to the headphone jack?	Yes	Replace the audio board.  Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.  Verify that the issue is resolved.	M24	OTHER BOARD
		No	Go to step 4.	#{nodeText.noSymptomCode}	
4.	Follow Service Guide procedures to remove the bottom case and disconnect the battery from the logic board.  Disconnect the microphone flex cable from the logic board. Inspect the cable and connectors on the logic board and microphone flex cable for any damage.  Did you find damage to this flex cable or any connectors?	Yes	Go to step 5.	#{nodeText.yesSymptomCode}	
		No	Go to step 6.	#{nodeText.noSymptomCode}	



	Check	Result	Action	Code	Commodity
5.	<p>Determine whether the damage is located on the flex cable, or other parts.</p> <p>Is the damage limited to the flex cable?</p>	Yes	<p>Microphone and its flex cable are part of top case assembly.</p> <p>Replace the top case assembly.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	K16	KEYBOARD
		No	<p><b>ESCALATION REQUIRED.</b></p> <p>Contact CSS for additional support or a multipart repair.</p>	\${nodeText.noSymptomCode}	
6.	<p>Reconnect the microphone flex cable to the logic board, verifying that the connectors are all seated properly.</p> <p>Retest by going to System Preferences &gt; Sound &gt; Input tab, and verifying that the input level indicator moves when speaking into the microphone.</p> <p>Is the internal microphone recognized and functional?</p>	Yes	Go to step 7.	\${nodeText.yesSymptomCode}	
		No	<p>Microphone and its flex cable are part of top case assembly.</p> <p>Replace the top case assembly.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	K36	KEYBOARD

	Check	Result	Action	Code	Commodity
7.	Run AST 2 Audio Test suite to verify that built-in microphone detects expected audio test patterns produced from each speaker.	Yes	<p>The issue was resolved by cleaning the audio jack or reseating the microphone flex cable.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	`\${nodeText.yesSymptomCode}`	
	Does the computer pass AST 2 Audio Test suite?	No	<p>Microphone and its flex cable are part of top case assembly.</p> <p>Replace the top case assembly.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	K36	KEYBOARD
8.	Verify that the internal microphone is available, selected, and functional, and that the input level indicator moves when speaking into the microphone. Then record a sample audio file and play it back to verify that it is free of distortion.	Yes	The issue is resolved.	`\${nodeText.yesSymptomCode}`	
	<p>Run AST 2 Post-Repair Diagnostic suite if available, to ensure no other issues remain.</p> <p>Is the issue resolved?</p>	No	<p><b>ESCALATION REQUIRED.</b></p> <p>Contact CSS for additional support or a multipart repair.</p>	`\${nodeText.noSymptomCode}`	

# Power Button or Touch ID Issues

## Unlikely causes:

**Likely Causes:** Touch ID board.

## Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none"><li>• Power button does not click properly or at all.</li><li>• Power button has stiff or spongy feel when pressed.</li><li>• Touch ID is unable to read user's fingerprint.</li><li>• Unable to enroll a user's finger in Touch ID.</li><li>• Unable to unlock computer using Touch ID.</li><li>• Unable to a make purchase using Apple Pay and Touch ID.</li></ul>	<p><b>Important:</b> Before performing any troubleshooting that requires disassembling the computer, ensure that you have installed the battery cover and disconnected the battery.</p> <ol style="list-style-type: none"><li>1. Restart the user's computer. After starting up, the user's computer will first prompt for a passcode, not a fingerprint, even if Touch ID is enabled. This is normal behavior. The only time the computer will authenticate using Touch ID is when waking from sleep, not when starting up.</li><li>2. On the computer, have the user go to System Preferences &gt; Touch ID to verify that user has enrolled at least one fingerprint. If no fingerprint is enrolled, Touch ID will be unable to function as expected.</li><li>3. Also in System Preferences &gt; Touch ID, verify that the box next to Unlocking your Mac is checked. If it is not, then Touch ID will not unlock the computer. Verify that the box next to iTunes &amp; App Store is checked. If it is not, then Touch ID cannot be used to make purchases in the iTunes Store, App Store, and iBooks Store. Refer to <a href="#">HT207054: Use Touch ID on your Mac</a> for more information about these settings.</li><li>4. Ensure that the customer's finger and the Touch ID sensor are clean. Check for dirt, debris, oils, lotions, or signs of damage. If necessary, clean the Touch ID sensor and the area surrounding it on the user's computer using a clean microfiber cloth.</li><li>5. Check for cases or protective films. Remove them if they are obstructing the Touch ID sensor or the area surrounding it and then retest for Touch ID functionality.</li><li>6. Have the user try to enroll another fingerprint on the same computer.</li><li>7. Remember that the user's finger needs to move slightly during enrollment. Also, ensure that the user waits for the computer's prompt before lifting a finger.</li><li>8. If user's finger does not reliably work on their computer, try enrolling the user's fingerprint on another known-good computer.</li><li>9. Enroll your own finger with the user's computer and retest for Touch ID functionality. Remove any non-user fingerprints from the computer when testing is complete so that you do not inadvertently leave your biometric information on a user's computer.</li><li>10. Do not service or replace the computer for issues with a specific finger or fingers. If the user has an issue with certain fingers, explain that in some cases Touch ID may be unable to match those fingers consistently. This is usually caused by the readability of that fingerprint, and the user can either try enrolling the fingerprint at a later time, or use a different finger for Touch ID.</li></ol> <p>If you and the user are unable to enroll any fingerprints on the computer, there is an issue with the Touch ID sensor and the computer should be serviced.</p> <ol style="list-style-type: none"><li>11. <b>Important:</b> Check for and apply the latest software and firmware updates to the user's computer. Retest for the user's original issue before continuing with further troubleshooting. To determine if the user's Mac needs updating, refer to <a href="#">HT201260: Find out which macOS your Mac is using</a>. To update macOS, refer to</li></ol>

	<p><a href="#">HT201541: How to update the software on your Mac.</a></p> <p>If an update is available, perform the update on the user's computer and repeat this process until no further updates are available. Then retest for the user's original issue before continuing with further troubleshooting.</p> <p>12. Refer to <a href="#">TP1907: Common Troubleshooting Procedures for Mac Computers with Apple Silicon</a> before performing further troubleshooting.</p>
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## Deep Dive

	Check	Result	Action	Code	Commodity
1.	Identify the type of issue:	A	Go to step 2.	`\${nodeText.yesSymptomCode}`	
	A. Touch ID issues such as: <ul style="list-style-type: none"> <li>Unable to read user's fingerprint</li> <li>Unable to enroll a user's fingerprint in Touch ID</li> <li>Unable to unlock computer using Touch ID</li> <li>Unable to make a purchase using Apple Pay and Touch ID</li> </ul> B. Power button issues such as: <ul style="list-style-type: none"> <li>Power button does not click properly or at all</li> <li>Power button has a stiff or spongy feel when pressed</li> </ul> Which issue is identified?	B	Go to step 8.	`\${nodeText.noSymptomCode}`	
2.	Run AST 2 Touch ID diagnostic suite on user's computer.	Yes	Go to step 3.	`\${nodeText.yesSymptomCode}`	
	Check diagnostic results to verify the functionality of Touch ID hardware.  If AST 2 is not available, repeat Quick Check steps to verify Touch ID functionality.  Does the computer pass all tests?	No	Go to step 4.	`\${nodeText.noSymptomCode}`	

	Check	Result	Action	Code	Commodity
3.	Repeat Quick Check steps to verify Touch ID functionality.	Yes	Issue cannot be duplicated.	#{nodeText.yesSymptomCode}	
	Touch ID is not responding as expected if: <ul style="list-style-type: none"> <li>There are authentication errors or failures on the user's computer when attempting to use any finger.</li> <li>Multiple people are having problems enrolling any fingerprint.</li> <li>Registration process cannot begin because the computer cannot detect any finger.</li> </ul>	No	Go to step 4.	#{nodeText.noSymptomCode}	
	Is Touch ID responding as expected?				
4.	Isolate the Touch ID issue to one of the following symptoms:	Intermittent Response	Go to step 5.	#{nodeText.yesSymptomCode}	
	<ul style="list-style-type: none"> <li>Intermittent response to finger</li> <li>No response to finger</li> </ul>	No Response	Go to step 6.	#{nodeText.noSymptomCode}	
	Which issue affects Touch ID?				
5.	Check for and apply the latest software and firmware updates to the user's computer.	Yes	Issue resolved by updating macOS.	#{nodeText.yesSymptomCode}	
	Run AST 2 Touch ID diagnostic suite on user's computer to retest Touch ID after software update.	No	Go to step 6.	#{nodeText.noSymptomCode}	
	Is the issue resolved after software update?				
6.	Follow Service Guide procedures to gain access to the Touch ID board in the top case.	Yes	Go to step 7.	#{nodeText.yesSymptomCode}	
	Disconnect the Touch ID board flex cable from the Audio Board.	No	Replace the Touch ID board.	M46	MPU
	Visually inspect the flex cable and connectors for damage.		Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.		
	Reconnect and reseal the Touch ID board flex cable to the Audio Board.				
	Are you able to reseal this cable?		Verify that the issue is resolved.		

	Check	Result	Action	Code	Commodity
7.	<p>Reassemble the computer.</p> <p>Run AST 2 Touch ID diagnostic suite on user's computer to retest Touch ID after reseating the Touch ID board flex cable.</p> <p>Is the issue resolved after reseating cable?</p>	Yes	Issue resolved by reseating Touch ID board flex cable.	`\${nodeText.yesSymptomCode}`	
		No	<p>Replace the Touch ID board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	M46	MPU
8.	<p>Inspect the opening on the top case for the power button.</p> <p>Determine whether the opening is misshapen or deformed, preventing proper button operation.</p> <p>Is the opening for the power button damaged or deformed?</p>	Yes	<p>Replace the top case assembly.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	K16	KEYBOARD
		No	Go to step 9.	`\${nodeText.noSymptomCode}`	

	Check	Result	Action	Code	Commodity
9.	Follow Service Guide procedures to remove the bottom case and the logic board to gain access to the Touch ID board in the top case.	Yes	Issue resolved by cleaning Touch ID board area in top case.	\${nodeText.yesSymptomCode}	
	Follow Service Guide procedures to remove the Touch ID board. Inspect the gap between the top case and the Touch ID board for debris.	No	Go to step 10.	\${nodeText.noSymptomCode}	
	If any debris is found that may interfere with power button operation, use compressed air to clean out the debris.				
	Follow Service Guide procedures to reassemble the computer and retest for both power button and Touch ID functionality.				
	Is the issue resolved?				
10.	Troubleshooting this issue completely requires a known-good Touch ID shim kit.  Do you have immediate access to a Touch ID shim kit?	Yes	Go to step 11.	\${nodeText.yesSymptomCode}	
		No	Order a Touch ID shim kit.  Return to this procedure when the kit is available.	X03	PIECE PART
11.	A button that feels too loose or too stiff can be caused by installing an incorrect shim that is too large or small.	Yes	Issue resolved by adjusting Touch ID board shim size.	\${nodeText.yesSymptomCode}	
	If the button is not aligned, then follow Service Guide procedures to realign the Touch ID board in the top case.	No	Replace the Touch ID board.	M48	MPU
	If the button feels too loose or has a spongy feel, then try a larger shim.		Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.		
	If the button feels too stiff or does not move, then try a smaller shim.		Verify that the issue is resolved.		
	Reinstall the same Touch ID board using the new shim.				
	Reassemble the computer and retest for both power button and Touch ID functionality.				
	Is the issue resolved?				

	Check	Result	Action	Code	Commodity
12.	Verify that the Touch ID or power button issue is no longer present  Run AST 2 Post-Repair Diagnostic suite if available, to ensure no other issues remain.  Is the issue resolved?	Yes	The issue is resolved.	\${nodeText.yesSymptomCode}	
		No	<b>ESCALATION REQUIRED.</b>  Contact CSS for additional support or a multipart repair.	\${nodeText.noSymptomCode}	



# Speaker or Headphone Jack Issues

**Unlikely causes:**

**Likely Causes:** Audio board, speaker set.

## Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none"><li>No sound from headphone jack.</li><li>No sound from left or right speakers.</li><li>Sound is distorted, fuzzy, or crackly.</li><li>Symptom only occurs with internal speakers.</li><li>Symptom only occurs with external speakers or headphones.</li></ul>	<p><b>Important:</b> Before performing any troubleshooting that requires disassembling the computer, ensure that you have installed the battery cover and disconnected the battery.</p> <ol style="list-style-type: none"><li>Refer to <a href="#">HT203186: If the internal speakers on your Mac aren't working</a>.</li><li>Go to System Preferences &gt; Sound, and verify the following:  Input tab:<ul style="list-style-type: none"><li>Internal Microphone is available and selected for sound input.</li><li>“Input volume” slider is not set to zero.</li></ul> Output tab:<ul style="list-style-type: none"><li>Internal Speakers is available and selected for sound output.</li><li>“Output volume” is not muted or set to zero.</li></ul></li><li>Go to System Preferences &gt; Sound &gt; Input tab, and verify that the “Input level” indicator moves when speaking into the microphone.</li><li>Check that no cables are inserted into the headphone jack. Use an otoscope to visually inspect jack. Use compressed air to clean and remove any debris.</li><li>Disconnect all peripheral devices and restart computer.</li><li>Important: Check for and apply the latest software and firmware updates to the user’s computer. Retest for the user’s original issue before continuing with further troubleshooting. To determine if the user’s Mac needs updating, refer to <a href="#">HT201260: Find out which macOS your Mac is using</a>. To update macOS, refer to <a href="#">HT201541: How to update the software on your Mac</a>.</li></ol> <p>If an update is available, perform the update on the user’s computer and repeat this process until no further updates are available. Then retest for the user’s original issue before continuing with further troubleshooting.</p> <ol style="list-style-type: none"><li>Refer to <a href="#">TP1907: Common Troubleshooting Procedures for Mac Computers with Apple Silicon</a> before performing further troubleshooting.</li></ol>

## Deep Dive

	Check	Result	Action	Code	Commodity
1.	Run AST 2 Audio Test suite to verify that left and right speakers produce expected audio test patterns from each speaker.	Yes	The issue cannot be duplicated.	<code>\$(nodeText.yesSymptomCode)</code>	
	Does the computer pass AST 2 Audio Test suite?	No	Go to step 2.	<code>\$(nodeText.noSymptomCode)</code>	

	Check	Result	Action	Code	Commodity
2.	Disconnect any connected headphones or external speakers. Go to System Preferences > Sound > Output tab and verify that Internal Speaker is available and selected for sound output.  Does System Preferences list “Headphones” instead?	Yes	Go to step 3.	`\${nodeText.yesSymptomCode}`	
		No	Go to step 4.	`\${nodeText.noSymptomCode}`	
3.	Debris in, or damage to, the headphone jack can cause the computer to become stuck in Headphone or External Speaker mode.  Use a lighted otoscope or magnifying glass to inspect for damage or debris inside the jack.  Use compressed air to clean and remove any debris.  Is there any damage to the headphone jack?	Yes	Replace the audio board.  Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.  Verify that the issue is resolved.	M24	OTHER BOARD
		No	Go to step 4.	`\${nodeText.noSymptomCode}`	
4.	Follow Service Guide procedures to remove the bottom case and disconnect the battery from the logic board.  Disconnect the audio board flex cable. Inspect the cable and connectors on the audio board flex cable for any damage.  Did you find damage to this flex cable or any connectors?	Yes	Go to step 5.	`\${nodeText.yesSymptomCode}`	
		No	Go to step 7.	`\${nodeText.noSymptomCode}`	
5.	Determine whether the damage is located on the flex cable, or other parts.  Is the damage limited to the flex cable?	Yes	Go to step 6.	`\${nodeText.yesSymptomCode}`	
		No	<b>ESCALATION REQUIRED.</b>  Contact CSS for additional support or a multipart repair.	`\${nodeText.noSymptomCode}`	

	Check	Result	Action	Code	Commodity
6.	<p>Some notebook models have a replaceable audio board flex cable and some models require replacement of the audio board. Refer to the Service Guide for more information.</p> <p>Is the audio board flex cable replaceable in this model?</p>	Yes	<p>Replace the audio board flex cable.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	X03	INTERNAL CABLE
		No	<p>Replace the audio board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	M09	OTHER BOARD
7.	Reconnect the audio board flex cable, verifying that the connectors are all seated properly.	Yes	Go to step 8.	\${nodeText.yesSymptomCode}	
	<p>Test the audio output from internal speakers.</p> <p>Can you hear audio through the internal speakers?</p>	No	Go to step 10.	\${nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
8.	<p>Connect known-good headphones or external speakers to test the output from the headphone jack. Verify you can hear audio.</p> <p>Can you hear audio through the headphones or external speakers?</p>	Yes	Go to step 9.	`\${nodeText.yesSymptomCode}`	
		No	<p>Replace the audio board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	M09	OTHER BOARD
9.	<p>Run AST 2 Audio Test suite to verify that left and right speakers produce expected audio test patterns from each speaker.</p> <p>Does the computer pass AST 2 Audio Test suite?</p>	Yes	<p>The issue was resolved by cleaning the headphone jack or reseating the audio board flex cable.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	`\${nodeText.yesSymptomCode}`	
		No	Go to step 10.	`\${nodeText.noSymptomCode}`	
10.	<p>Follow Service Guide procedures to remove the bottom case and disconnect the battery from the logic board.</p> <p>Locate speaker connections on logic board. Disconnect and inspect both speaker cable connectors and corresponding connectors on logic board for damage.</p> <p>Reconnect the left and right speakers to the logic board, verifying that the connections are all seated properly.</p> <p>Did you find damage to speakers or logic board connector?</p>	Yes	Go to step 11.	`\${nodeText.yesSymptomCode}`	
		No	Go to step 12.	`\${nodeText.noSymptomCode}`	

	Check	Result	Action	Code	Commodity
11.	<p>Determine whether damage is on the logic board, speakers, or both.</p> <p>Is the damage limited to speakers?</p>	Yes	<p>Speakers are replaced as a matched set. Replace speakers with a matched-pair replacement kit.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	X03	OTHER ELECTRIC
		No	<p><b>ESCALATION REQUIRED.</b></p> <p>Contact CSS for additional support or a multipart repair.</p>	\${nodeText.noSymptomCode}	
12.	<p>With speaker connectors reseated to logic board, verify that you can hear audio through internal speakers.</p> <p>In System Preferences &gt; Sound &gt; Output tab, adjust Balance slider to check left and right speaker channel separation.</p> <p>Play music with high and low tones to check bass and tweeter performance of left and right speakers.</p> <p>Do internal speakers present full range of expected audio performance, without distortion?</p>	Yes	<p>The issue was resolved by reseating cables. Verify resolution.</p>	\${nodeText.yesSymptomCode}	
		No	<p>Speakers are replaced as a matched set. Replace speakers with a matched-pair replacement kit.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	X08	OTHER ELECTRIC

	Check	Result	Action	Code	Commodity
13.	Connect and disconnect headphones or external speakers. Verify that audio can be played through both external and internal speakers, and that sound is clear and free of distortion.  Run AST 2 Post-Repair Diagnostic suite if available, to ensure no other issues remain.  Is the issue resolved?	Yes	The issue is resolved.	\${nodeText.yesSymptomCode}	
		No	<b>ESCALATION REQUIRED.</b>  Contact CSS for additional support or a multipart repair.	\${nodeText.noSymptomCode}	

# Trackpad Issues

**Unlikely causes:**

**Likely Causes:** Trackpad.

## Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none"><li>Cursor does not move with trackpad input.</li><li>Multi-Touch features are inoperable.</li><li>Trackpad does not respond to clicks.</li><li>Trackpad has Haptic feedback issues.</li></ul>	<p><b>Important:</b> Before performing any troubleshooting that requires disassembling the computer, ensure that you have installed the battery cover and disconnected the battery.</p> <ol style="list-style-type: none"><li>Check for environmental factors such as humidity, hand lotion, or jewelry. Check to see whether the user is touching the trackpad simultaneously with both hands.</li><li>With the computer off, clean the trackpad surface using a clean, dry, lint-free cloth.</li><li>In System Preferences &gt; Accessibility/Universal Access, disable all assisted “Keyboard” and “Mouse &amp; Trackpad” settings. Retest trackpad functionality.</li><li>In System Preferences &gt; Trackpad, check and adjust Click pressure and Trackpad speed. Too-high or too-low settings may be perceived as trackpad issues.</li><li>Disconnect all Bluetooth devices. In System Preferences &gt; Bluetooth, click the ‘X’ button next to every device.</li><li><b>Important:</b> Check for and apply the latest software and firmware updates to the user’s computer. Retest for the user’s original issue before continuing with further troubleshooting. To determine if the user’s Mac needs updating, refer to <a href="#">HT201260: Find out which macOS your Mac is using</a>. To update macOS, refer to <a href="#">HT201541: How to update the software on your Mac</a>.</li></ol> <p>If an update is available, perform the update on the user’s computer and repeat this process until no further updates are available. Then retest for the user’s original issue before continuing with further troubleshooting.</p> <ol style="list-style-type: none"><li>Refer to <a href="#">TP1907: Common Troubleshooting Procedures for Mac Computers with Apple Silicon</a> before performing further troubleshooting.</li></ol>

## Deep Dive

	Check	Result	Action	Code	Commodity
1.	Run AST 2 Trackpad diagnostic suite.	Yes	Go to step 5.	<code>\${nodeText.yesSymptomCode}</code>	
	The diagnostic is Multi-Touch capable and will instruct you to touch every part of the trackpad surface to verify its Multi-Touch functionality.	No	Go to step 2.	<code>\${nodeText.noSymptomCode}</code>	
	Does the computer pass Trackpad diagnostic suite?				

	Check	Result	Action	Code	Commodity
2.	<p>Follow Service Guide procedures to remove the bottom case and disconnect the battery from the logic board.</p> <p>Disconnect and inspect the trackpad or IPD flex cable and its connectors, looking for connector or cable damage.</p> <p>Also check for damage on the trackpad, keyboard, and logic board keyboard or IPD flex connectors.</p> <p>Did you find damage to this flex cable or any connectors?</p>	Yes	Go to step 3.	\${nodeText.yesSymptomCode}	
		No	Go to step 4.	\${nodeText.noSymptomCode}	
3.	<p>Determine whether the damage is located on the flex cable, or other parts.</p> <p>Is the damage limited to the flex cable?</p>	Yes	<p>Replace the trackpad flex cable or IPD flex cable (depending on model).</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	X03	INTERNAL CABLE
		No	<p><b>ESCALATION REQUIRED.</b></p> <p>Contact CSS for additional support or a multipart repair.</p>	\${nodeText.noSymptomCode}	



	Check	Result	Action	Code	Commodity
4.	<p>Carefully reinstall and reseal the trackpad or IPD flex cable.</p> <p>Reassemble the computer and run diagnostics again.</p> <p>Does computer pass Trackpad Diagnostic?</p>	Yes	<p>Issue resolved by reseating trackpad flex cable or IPD flex cable (depending on model).</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	<p>{nodeText.yesSymptomCode}</p>	
		No	Go to step 5.	<p>{nodeText.noSymptomCode}</p>	
5.	<p>Instead of a standard button, this trackpad uses a force sensor to sense clicks, and a linear actuator to simulate the feeling of a click.</p> <p>Run AST 2 Trackpad Calibration Check suite to verify the proper functionality of these components, as well as to recalibrate them if necessary.</p> <p>Refer to <a href="#">TP1314: Trackpad Calibration Check</a> for instructions.</p> <p>Important: The calibration check is a very sensitive diagnostic. It requires the use of 200 g and 800 g weights, and must be run on a very stable, flat, and undisturbed work surface. Disruptions to the work surface or misplacement of the weights may cause failures or incorrectly calibrate the trackpad.</p> <p>If the computer fails diagnostic on the first try, it is a good idea to run the diagnostic again after verifying proper weight placement, and that there is no disturbance to the work surface.</p> <p>Does the computer pass Trackpad Calibration Check?</p>	Yes	Go to step 6.	<p>{nodeText.yesSymptomCode}</p>	
		No	<p>Replace the trackpad.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	<p>K99</p>	MOUSE

	Check	Result	Action	Code	Commodity
6.	<p>After running Trackpad Calibration Check, verify the functionality of the trackpad, since recalibration may have occurred.</p> <p>Is the trackpad functioning properly?</p>	Yes	Issue resolved. Verify resolution.	\${nodeText.yesSymptomCode}	
		No	<p><b>ESCALATION REQUIRED.</b></p> <p>If you suspect a problem even though the computer passed all trackpad diagnostics, contact CSS for additional support.</p>	\${nodeText.noSymptomCode}	
7.	<p>Check trackpad functionality, including Multi-Touch, click, secondary click, and Force click.</p> <p>For full verification, run the following AST 2 diagnostics suites:</p> <ul style="list-style-type: none"> <li>Trackpad (Multi-Touch surface test)</li> <li>Trackpad Calibration Check</li> </ul> <p>Run AST 2 Post-Repair Diagnostic suite if available, to ensure no other issues remain.</p> <p>Is the issue resolved?</p>	Yes	The issue is resolved.	\${nodeText.yesSymptomCode}	
		No	<p><b>ESCALATION REQUIRED.</b></p> <p>Contact CSS for additional support or a multipart repair.</p>	\${nodeText.noSymptomCode}	

# USB-C and Thunderbolt Issues

## Unlikely causes:

**Likely Causes:** I/O board, top case assembly.

## Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none"><li>USB-C devices are not recognized or not powered when connected to computer's USB-C ports.</li><li>External Thunderbolt devices or displays are not recognized when connected to computer's USB-C ports.</li><li>External HDMI display is not recognized when connected to computer's USB-C ports, using an adapter.</li></ul>	<p><b>Important:</b> Before performing any troubleshooting that requires disassembling the computer, ensure that you have installed the battery cover and disconnected the battery.</p> <ol style="list-style-type: none"><li>Verify that the user is not exceeding the specified maximum number of supported external USB-C devices or displays for this model. Two external displays are supported.</li><li>Refer to <a href="#">HT201163: About USB on Mac computers</a>.</li><li>Important: Check for and apply the latest software and firmware updates to the user's computer. Retest for the user's original issue before continuing with further troubleshooting. To determine if the user's Mac needs updating, refer to <a href="#">HT201260: Find out which macOS your Mac is using</a>. To update macOS, refer to <a href="#">HT201541: How to update the software on your Mac</a>. If an update is available, perform the update on the user's computer and repeat this process until no further updates are available. Then retest for the user's original issue before continuing with further troubleshooting.</li><li>Also check for adapter firmware updates by leaving the user's adapter connected to the computer while running software update. If an update is available, update the adapter's firmware before proceeding further, and retest for USB-C connectivity issues.</li><li>Refer to <a href="#">TP1907: Common Troubleshooting Procedures for Mac Computers with Apple Silicon</a> before performing further troubleshooting.</li><li>Refer to the following articles to learn more about Thunderbolt connectivity in this computer:<ul style="list-style-type: none"><li><a href="#">HT207443: Adapters for the Thunderbolt 3 (USB-C) or USB-C port on your Mac or iPad Pro</a></li></ul></li></ol>

## Deep Dive

	Check	Result	Action	Code	Commodity
1.	Inspect all USB-C ports and top case openings on the user's computer for any signs of deformation, damage, or debris that may be blocking the connection. Use compressed air to clear any obstructions or debris.	Yes	Go to step 2.	<code>\${nodeText.yesSymptomCode}</code>	
	<b>Important:</b> Do not use any metal objects to clear debris or obstructions, as this can short the connector and cause damage.	No	Go to step 3.	<code>\${nodeText.noSymptomCode}</code>	
	Is any USB-C port damaged?				

	Check	Result	Action	Code	Commodity
2.	<p>Inspect the opening on the top case for the USB-C port. Determine whether the opening is misshapen or deformed, preventing proper insertion of the USB plugs.</p> <p>Is the opening for the USB-C port damaged or deformed?</p>	Yes	<p>Replace the top case assembly.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	K16	KEYBOARD
		No	<p>Replace the I/O board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	M24	OTHER BOARD

	Check	Result	Action	Code	Commodity
3.	<p>Connect the user's computer to a known-good Apple USB-C power adapter with a known-good Apple USB-C charging cable that is the correct type for the user's computer.</p> <p>Connect the power adapter to a known-good electrical outlet.</p> <p>Check that the computer recognizes the power adapter.</p> <p>The computer should turn on automatically if it is off when the power adapter is connected.</p> <p>Verify in System Information &gt; Power &gt; AC Charger Information that the computer recognizes the power adapter.</p> <p>Test both orientations of the connector.</p> <p>Repeat for all USB-C ports.</p> <p>Does the computer recognize the power adapter, turn on, and begin to charge?</p>	Yes	Go to step 5.	#{nodeText.yesSymptomCode}	
		No	Go to step 4.	#{nodeText.noSymptomCode}	
4.	<p>Follow Service Guide procedures to remove the bottom case and disconnect the battery from the logic board.</p> <p>Disconnect then reconnect the I/O board that is related to the affected USB-C port to reseat the connection to the logic board. Reassemble the computer.</p> <p>Connect the user's computer to a known-good power adapter and charging cable that is connected to a known-good electrical outlet.</p> <p>The computer should turn on automatically if it is off when the power adapter is connected.</p> <p>Verify in System Information &gt; Power &gt; AC Charger Information that the computer recognizes the power adapter.</p> <p>Does the computer recognize the power adapter, turn on, and begin to charge?</p>	Yes	Go to step 5.	#{nodeText.yesSymptomCode}	
		No	<p>Replace the I/O board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	M21	OTHER BOARD

	Check	Result	Action	Code	Commodity
5.	<p>Connect a known-good USB-C device, such as an external disk, to the USB-C port on the computer.</p> <p>Verify in System Information &gt; USB that the device is detected.</p> <p>Test both orientations of the connector.</p> <p>Repeat for all USB-C ports.</p> <p>Is the USB-C device detected?</p>	Yes	Go to step 6.	#{nodeText.yesSymptomCode}	
		No	<p>Replace the I/O board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	M37	OTHER BOARD
6.	<p>Connect a known-good Thunderbolt device such as an external disk to the same USB-C port on the computer.</p> <p>Verify in System Information &gt; Thunderbolt that the device is detected.</p> <p>Test both orientations of the connector.</p> <p>Repeat for all USB-C ports.</p> <p>Is the Thunderbolt device detected?</p>	Yes	Go to step 7.	#{nodeText.yesSymptomCode}	
		No	<p>Replace the I/O board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	M15	OTHER BOARD

	Check	Result	Action	Code	Commodity
7.	Connect a known-good external Thunderbolt or HDMI display to the user's computer (using a compatible adapter).	Yes	The issue is isolated to the user's USB-C or Thunderbolt peripheral or adapter.	`\${nodeText.yesSymptomCode}`	
	<p>If the display is equipped with internal speakers, also verify audio output.</p> <p>On the user's computer, in System Preferences &gt; Sound &gt; Output, select the external display for sound output.</p> <p>On the display, verify that the correct input has been selected.</p> <p>Verify that a good image appears on the external display.</p> <p>Test the audio output using more than one application or website.</p> <p>Test both orientations of the connector.</p> <p>Repeat for all USB-C ports.</p> <p>Do all test perform as expected?</p>	No	<p>Replace the I/O board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	M37	OTHER BOARD
8.	Confirm that known-good USB and Thunderbolt devices are functional and recognized when connected to all USB-C ports on the computer, in both orientations.	Yes	The issue is resolved.	`\${nodeText.yesSymptomCode}`	
	<p>Run AST 2 Post-Repair Diagnostic suite if available, to ensure no other issues remain.</p> <p>Is the issue resolved?</p>	No	<p><b>ESCALATION REQUIRED.</b></p> <p>Contact CSS for additional support or a multipart repair.</p>	`\${nodeText.noSymptomCode}`	

# Computer Feels Unusually Warm or has Unusual Odors

## Unlikely causes:

**Likely Causes:** Battery, fan, IPD flex cable, logic board, top case assembly, trackpad.

## Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none"><li>• Computer feels unusually warm.</li><li>• Computer or power adapter emits a burning, smoky, or other unusual odor.</li><li>• Excessive fan noise.</li></ul>	<p><b>Important:</b> Before performing any troubleshooting that requires disassembling the computer, ensure that you have installed the battery cover and disconnected the battery.</p> <ol style="list-style-type: none"><li>1. Disconnect all peripheral devices and restart computer.</li><li>2. Verify the temperature issue with the computer resting on a hard, flat surface. <b>Note:</b> Use this opportunity to educate the user about inappropriate work surfaces that may cause the computer to overheat. Refer to article <a href="#">HT201640: Keep your Mac notebook within acceptable operating temperatures</a>.</li><li>3. Compare the computer's operating temperature to a known-good, similarly configured computer.</li><li>4. Be aware that new computers will run hotter and louder during initial setup and Spotlight indexing. This is normal behavior and is not considered a service issue.</li><li>5. Check for runaway applications using the information in <a href="#">HT203184: See how apps affect Mac performance, battery runtime, temperature, and fan activity</a>. Follow the instructions to halt any processes that are using excessive system resources.</li><li>6. Processor-intensive or graphics-intensive applications and system processes may cause the bottom case to feel warm. Use Activity Monitor to identify these types of applications and explain the issue to the user.</li><li>7. <b>Important:</b> Check for and apply the latest software and firmware updates to the user's computer. Retest for the user's original issue before continuing with further troubleshooting. To determine if the user's Mac needs updating, refer to <a href="#">HT201260: Find out which macOS your Mac is using</a>. To update macOS, refer to <a href="#">HT201541: How to update the software on your Mac</a>.</li></ol> <p>If an update is available, perform the update on the user's computer and repeat this process until no further updates are available. Then retest for the user's original issue before continuing with further troubleshooting.</p> <ol style="list-style-type: none"><li>8. Inspect the enclosure and components for obvious signs of burning or smoky residue. Check the rear vents, keyboard, slots, and ports, as well as the power adapter, USB-C connector, and charging cable.</li><li>9. Clean the enclosure to eliminate any causes due to external contamination.</li><li>10. Verify that the vents allow unobstructed airflow into and out of the computer.</li><li>11. Refer to <a href="#">TP1907: Common Troubleshooting Procedures for Mac Computers with Apple Silicon</a> before performing further troubleshooting.</li></ol>

## Deep Dive



	Check	Result	Action	Code	Commodity
1.	<p>Determine whether this is a safety issue.</p> <p>Do not perform procedures that can be a safety risk to you or the user.</p> <p>Have you identified a safety issue?</p>	Yes	<p><b>ESCALATION REQUIRED.</b></p> <p>Contact CSS for safety-related issues. Refer to article <a href="#">OP44: Handling Potential Product Safety Issues</a>.</p> <p>Retail: Document the issue and escalate following the steps in <a href="#">RS60: Product Safety Escalations</a>.</p>	\${nodeText.yesSymptomCode}	
		No	Go to step 2.		
2.	<p>Determine if the computer is unusually warm or has unusual odors:</p> <p>A. Unusually warm</p> <p>B. Unusual odors</p> <p>Which issue is identified?</p>	Yes	Go to step 3.	\${nodeText.yesSymptomCode}	
		No	Go to step 19.		
3.	<p>While connected to the user's power adapter and charging cable, run AST 2 Mac Resource Inspector diagnostic suite (MRI) to gather diagnostic information about the computer.</p> <p>MRI will report a failure if any sensors are not detected or are exceeding expected thermal values.</p> <p>Does the computer pass all MRI tests?</p>	Yes	Go to step 4.	\${nodeText.yesSymptomCode}	
		No	Go to step 5.		
4.	<p>Run AST 2 Cooling System Diagnostic (CSD) diagnostics suite.</p> <p>CSD works like a stress test on the computer, gathering information about the thermal performance while various components are under heavy use.</p> <p>Does the computer pass all CSD tests?</p>	Yes	<p>The computer passed all thermal checks and is operating within specifications. Verify correct operation and refer the customer to <a href="#">HT201640: Keep your Mac notebook within acceptable operating temperatures</a>.</p>	\${nodeText.yesSymptomCode}	
		No	Go to step 5.		

	Check	Result	Action	Code	Commodity
5.	<p>A disconnected or malfunctioning fan will prevent proper cooling and may cause thermal sensors to exceed expected values. An obstructed fan or heat sink may also cause excessive fan noise.</p> <p>Check diagnostic results for fan motor failures.</p> <p><b>Note:</b> Some computer models do not have a fan. Reply 'NO' to skip this question and continue troubleshooting for models without a fan.</p> <p>Did diagnostics report any fan motor test failure?</p>	Yes	Go to step 6.	\${nodeText.yesSymptomCode}	
		No	Go to step 10.	\${nodeText.noSymptomCode}	
6.	<p>Follow Service Guide procedures to remove the bottom case and disconnect the battery from the logic board.</p> <p>Disconnect and inspect the fan flex cable and its connectors, looking for connector or cable damage.</p> <p>Also check for damage on the logic board fan flex connectors.</p> <p>Did you find damage to this flex cable or any connectors?</p>	Yes	Go to step 7.	\${nodeText.yesSymptomCode}	
		No	Go to step 8.	\${nodeText.noSymptomCode}	
7.	<p>Determine whether the damage is located on the flex cable, or other parts.</p> <p>Is the damage limited to the flex cable?</p>	Yes	<p>Replace the trackpad flex cable or IPD flex cable (depending on model).</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	X03	INTERNAL CABLE
		No	<p><b>ESCALATION REQUIRED.</b></p> <p>Contact CSS for additional support or a multipart repair.</p>	\${nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
8.	Carefully reseal the fan flex cable into its connector.	Yes	Go to step 9.	\${nodeText.yesSymptomCode}	
	Reassemble the computer and run diagnostics again.	No	Issue resolved by reseating fan flex cable. Verify resolution.	\${nodeText.noSymptomCode}	
	Do diagnostics still report a fan failure?				
9.	Remove the fan to reveal inner side of heat sink. Use an ESD-safe vacuum to remove dust and debris from heat sink and fan.	Yes	Replace the fan.  Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.	X22	OTHER ELECTRIC
	Reassemble the computer and run diagnostics again.	No	Verify that the issue is resolved.		
	Do diagnostics still report a fan failure?				
10.	Check diagnostic results for trackpad thermal sensor errors.	Yes	Go to step 11.	\${nodeText.yesSymptomCode}	
	Did diagnostics report any trackpad thermal sensor errors?	No	Go to step 15.	\${nodeText.noSymptomCode}	
11.	Run AST 2 Trackpad diagnostic suite.	Yes	Go to step 15.	\${nodeText.yesSymptomCode}	
	The diagnostic is Multi-Touch capable and will instruct you to touch every part of the trackpad surface to verify its Multi-Touch functionality.	No	Go to step 12.	\${nodeText.noSymptomCode}	
	Does the computer pass Trackpad diagnostic suite?				
12.	Follow Service Guide procedures to remove the bottom case and disconnect the battery from the logic board.	Yes	Go to step 13.	\${nodeText.yesSymptomCode}	
	Disconnect and inspect the trackpad or IPD flex cable and its connectors, looking for connector or cable damage.	No	Go to step 14.	\${nodeText.noSymptomCode}	
	Also check for damage on the trackpad, keyboard, and logic board keyboard or IPD flex connectors.				
	Did you find damage to this flex cable or any connectors?				

	Check	Result	Action	Code	Commodity
13.	<p>Determine whether the damage is located on the flex cable, or other parts.</p> <p>Is the damage limited to the flex cable?</p>	Yes	<p>Replace the trackpad flex cable or IPD flex cable (depending on model).</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	X03	INTERNAL CABLE
		No	<p><b>ESCALATION REQUIRED.</b></p> <p>Contact CSS for additional support or a multipart repair.</p>	\${nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
14.	<p>Carefully reinstall and reseal the trackpad or IPD flex cable.</p> <p>Reassemble the computer and run diagnostics again.</p> <p>Does computer pass Trackpad Diagnostic?</p>	Yes	<p>Issue resolved by reseating trackpad flex cable or IPD flex cable (depending on model).</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	<p>{nodeText.yesSymptomCode}</p>	
		No	<p>Replace the trackpad.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	<p>K85</p>	<p>MOUSE</p>
15.	<p>Check diagnostic results for battery thermal sensor errors.</p> <p>Did diagnostics report any battery thermal sensor errors?</p>	Yes	<p>Go to step 16.</p>	<p>{nodeText.yesSymptomCode}</p>	
		No	<p>Go to step 18.</p>	<p>{nodeText.noSymptomCode}</p>	
16.	<p>While connected to the user's power adapter and charging cable, run AST 2 Mac Resource Inspector diagnostic suite (MRI) to gather diagnostic information about the battery.</p> <p>Check MRI results for any battery-specific warnings or failures.</p> <p>Does MRI report any battery errors?</p>	Yes	<p>Go to step 17.</p>	<p>{nodeText.yesSymptomCode}</p>	
		No	<p>Go to step 18.</p>	<p>{nodeText.noSymptomCode}</p>	

	Check	Result	Action	Code	Commodity
17.	<p>Some notebook models have a replaceable battery and some models require replacement of the top case assembly. Refer to the Service Guide for more information.</p> <p>Is the battery replaceable in this model?</p>	Yes	<p>Replace the battery.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	P17	BATTERY
		No	<p>Replace the top case assembly.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	K85	KEYBOARD
18.	<p>Check diagnostic results for failures related to any other logic board thermal sensor errors</p> <p>Did diagnostics report any logic board thermal sensor errors?</p>	Yes	<p>Replace the logic board and Touch ID board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	M18	MLB
		No	Go to step 19.	\$_{nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
19.	<p>An odor can be related to external contamination. Inspect the computer exterior for contamination or lack of cleanliness.</p> <p>Can you determine that the odor is caused by external contamination?</p>	Yes	Go to step 20.	#{nodeText.yesSymptomCode}	
		No	Go to step 21.	#{nodeText.noSymptomCode}	
20.	<p>Thoroughly clean enclosure and all external surfaces. Refer to <a href="#">HT204172: How to clean your Apple products</a>. Explain the cause to the user.</p> <p>Does user agree that the odor is due to external contamination?</p>	Yes	The issue is resolved. Verify resolution.	#{nodeText.yesSymptomCode}	
		No	<p><b>ESCALATION REQUIRED.</b></p> <p>Contact CSS for additional support or a multipart repair.</p>	#{nodeText.noSymptomCode}	
21.	<p>Odors can be related to product newness. Refer to <a href="#">HT202324: Odors may be present short-term</a>.</p> <p>Can you determine that the odor is due to the product being new?</p>	Yes	Go to step 22.	#{nodeText.yesSymptomCode}	
		No	Go to step 23.	#{nodeText.noSymptomCode}	
22.	<p>Explain to the user that new computers can sometimes emit an odor, similar to odors generated from new carpeting or a new car. In most cases, the odor dissipates after a brief period.</p> <p>Does the user agree that the odor is related to the computer being new?</p>	Yes	The issue is resolved. Verify resolution.	#{nodeText.yesSymptomCode}	
		No	<p><b>ESCALATION REQUIRED.</b></p> <p>Contact CSS for additional support or a multipart repair.</p>	#{nodeText.noSymptomCode}	
23.	<p>Closely inspect internal components and the enclosure for indications of physical or liquid damage or contamination.</p> <p>Refer to <a href="#">TP1150: Visual/Mechanical Inspection (VMI) Guide for Mac Liquid Damage</a> for guidance regarding possible liquid damage to the user's computer.</p> <p>Can you identify signs of internal damage or contamination?</p>	Yes	Go to "Mechanical, Physical, or Cosmetic Damage".	#{nodeText.yesSymptomCode}	
		No	Go to step 24.	#{nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
24.	Closely inspect internal hardware and the enclosure for other possible causes of odor, such as bulging or vented chip capacitors, or visible residue or burn marks on the enclosure, logic board, or other components.	Yes	<b>ESCALATION REQUIRED.</b>  Contact CSS for additional support or a multipart repair.	\${nodeText.yesSymptomCode}	
	Have you identified a component failure as the source of the odor?	No	The issue cannot be duplicated.	\${nodeText.noSymptomCode}	
25.	Use Cooling System Diagnostic to verify that the computer is running within thermal specifications.	Yes	The issue is resolved.	\${nodeText.yesSymptomCode}	
	Run AST 2 Post-Repair Diagnostic suite if available, to ensure no other issues remain.  Is the issue resolved?	No	<b>ESCALATION REQUIRED.</b>  Contact CSS for additional support or a multipart repair.	\${nodeText.noSymptomCode}	



# Mechanical, Physical, Cosmetic, Battery, or Display Damage

## Unlikely causes:

There are no unlikely causes for this issue.

## Quick Check

Symptoms	Quick Check
<p>The computer shows signs of physical or cosmetic damage such as:</p> <ul style="list-style-type: none"><li>• Enclosure and Battery:<ul style="list-style-type: none"><li>• Loose or broken hinges.</li><li>• Stripped, loose, or missing screw.</li><li>• Liquid spill.</li><li>• One or more battery cells have increased in size.</li><li>• Computer wobbles and will not sit evenly on flat surface.</li><li>• Bottom case cannot be reinstalled.</li></ul></li><li>• Display Assembly:<ul style="list-style-type: none"><li>• Cracked or broken display frame or assembly housing, or cracked display glass.</li><li>• Scratches.</li><li>• Dents.</li><li>• Liquid spill.</li></ul></li><li>• Keyboard and Top Case:<ul style="list-style-type: none"><li>• Worn paint on one or more keys on the built-in keyboard.</li><li>• Scratches.</li><li>• Dents.</li><li>• Liquid spill.</li></ul></li><li>• AC Power Adapter:<ul style="list-style-type: none"><li>• Mechanical damage to adapter connector, cable, or housing.</li><li>• Scratches.</li><li>• Dents.</li><li>• Liquid spill.</li></ul></li></ul> <p><b>Note:</b> Inform the user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options. Refer to <a href="#">OP14: Determining and quoting accidental damage for Mac portables</a>.</p>	<p><b>Important:</b> Before performing any troubleshooting that requires disassembling the computer, ensure that you have installed the battery cover and disconnected the battery.</p> <ol style="list-style-type: none"><li>1. Inspect the computer and discuss the nature of the issue with the user. Determine whether the user wants to proceed with the repair (despite possible accidental damage) or pursue other service options. Click “No” to proceed with further troubleshooting.</li><li>2. Refer to <a href="#">TP1151: Visual/Mechanical Inspection (VMI) Guide for Mac Computers - Table of Contents</a> for guidance regarding possible damage to the user's computer.</li><li>3. Check for correct installation of bottom case. An expanded battery may be preventing complete installation of the bottom case cover.</li><li>4. Refer to <a href="#">OP14: Determining and quoting accidental damage for Mac portables</a> to check for causes that would prevent correct installation of the bottom case or battery.</li><li>5. Refer to <a href="#">HT204762: Enclosure separation due to expanded or swollen battery</a>.</li><li>6. Follow the guidelines in <a href="#">OP693: Embedded battery visual inspection</a>.</li><li>7. Follow the guidelines in <a href="#">OP24: Safely handling lithium batteries and lithium battery-powered devices</a>.</li><li>8. Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</li></ol>

## Deep Dive

	Check	Result	Action	Code	Commodity
1.	Determine whether issue involves a safety risk.	Yes	<b>ESCALATION REQUIRED.</b>	\${nodeText.yesSymptomCode}	
	Do not perform procedures that can be a safety risk to you or the user.		Contact CSS for safety-related issues. Refer to <a href="#">OP44: Handling Potential Product Safety Issues</a> .		
	Have you identified a safety issue?	No	Retail: Document the issue and escalate following the steps in <a href="#">RS60: Product Safety Escalations</a> . Go to step 2.	\${nodeText.noSymptomCode}	

	Follow Service Guide procedures to remove the bottom case and disconnect the battery from the logic board.	Yes	Go to step 3.	`\${nodeText.yesSymptomCode}`	
	<p>Inspect the battery for any sign of battery cell puncture, leakage, venting, or cell deformation.</p> <p>Refer to section five of <a href="#">OP24: Safely handling lithium batteries and lithium battery-powered devices</a>, titled “Venting batteries.”</p> <p>Recognize battery cell electrolyte leakage.</p> <p>Apply a protective battery cover to the computer battery that is being serviced.</p>				
2.	<p><b>If a battery cell is leaking:</b></p> <ol style="list-style-type: none"> <li>1. Keep all personnel at a safe distance to prevent persons from coming in contact with spilled material.</li> <li>2. Eliminate all ignition sources and other debris (no heat sources, sparks, or flames in immediate area).</li> </ol> <p>A leaking battery should only be handled by trained and properly equipped personnel.</p> <p>Are any battery cells punctured, leaking, or deformed?</p>	No	Go to step 4.	`\${nodeText.noSymptomCode}`	

	Check	Result	Action	Code	Commodity
3.	Inspect the top case assembly for any physical damage.	Yes	<b>ESCALATION REQUIRED.</b>  Contact CSS for additional support or a multipart repair.	\${nodeText.yesSymptomCode}	
	Replacement of multiple parts requires an escalation to CSS for repair approval.				
	Does the top case require replacement?	No	Go to step 6.	\${nodeText.noSymptomCode}	
4.	Check the battery and bottom case installation. Verify that the battery has not expanded to deform the enclosure or separate the bottom case and top case.	Yes	Go to step 5.	\${nodeText.yesSymptomCode}	
	One or more battery cells might have expanded, resulting in pressure on the bottom case cover.  Refer to <a href="#">OP693: Embedded battery visual inspection</a> .  Place a protective battery cover on the computer being serviced.  Has one or more battery cells expanded in size?	No	Go to step 7.	\${nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
5.	Inspect the bottom case for deformation due to battery swelling.	Yes	<b>ESCALATION REQUIRED.</b>	`\${nodeText.yesSymptomCode}`	
	Check that the bottom case can be installed correctly on new top case.		Contact CSS for additional support or a multipart repair.		
	Replacement of multiple parts requires an escalation to CSS for repair approval.	No	Go to step 6.	`\${nodeText.noSymptomCode}`	
6.	Does the bottom case require replacement?				
	Some notebook models have a replaceable battery and some models require replacement of the top case assembly. Refer to the Service Guide for more information.	Yes	<p>Replace the battery.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	P13	BATTERY
	Is the battery replaceable in this model?	No	<p>Replace the top case assembly.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	K33	KEYBOARD
7.	Closely examine the user's computer for signs of enclosure damage as described in symptoms.	Yes	<p>Proceed with repair creation to see available options. Inform the user that computer failures due to accidental damage are not covered by Apple's one-year limited warranty or the AppleCare Protection Plan (APP).</p> <p>Refer to <a href="http://www.apple.com/legal/warranty">www.apple.com/legal/warranty</a> for details.</p>	X12	ENCLOSURE
	Does the computer exhibit this type of damage?	No	Go to step 8.	`\${nodeText.noSymptomCode}`	

	Check	Result	Action	Code	Commodity
8.	Closely examine the user's computer enclosure for signs of liquid spill damage.	Yes	Proceed with repair creation to see available options. Inform the user that computer failures due to accidental damage are not covered by Apple's one-year limited warranty or the AppleCare Protection Plan (APP).  Refer to <a href="http://www.apple.com/legal/warranty">www.apple.com/legal/warranty</a> for details.	X90	ENCLOSURE
	Look for any signs of liquid spill, liquid penetration, or liquid damage to the computer's enclosure.				
	Does the computer exhibit this type of damage?	No	Go to step 9.	`\${nodeText.noSymptomCode}`	
9.	Closely examine the user's computer for signs of display assembly damage, such as a cracked or broken display frame or assembly housing, or cracked display glass.	Yes	Refer to <a href="#">TP1138: Visual/Mechanical Inspection (VMI) Guide for Mac Displays</a> for specific instructions and criteria regarding cracked displays.  Proceed with repair creation to see available options. Inform the user that computer failures due to accidental damage are not covered by Apple's one-year limited warranty or the AppleCare Protection Plan (APP).  Refer to <a href="http://www.apple.com/legal/warranty">www.apple.com/legal/warranty</a> for details.	L99	LCD
	Does the computer exhibit this type of damage?				
		No	Go to step 10.	`\${nodeText.noSymptomCode}`	
10.	Closely examine the user's computer display assembly for signs of cosmetic damage, such as:	Yes	Proceed with repair creation to see available options. Inform the user that computer failures due to accidental damage are not covered by Apple's one-year limited warranty or the AppleCare Protection Plan (APP).  Refer to <a href="http://www.apple.com/legal/warranty">www.apple.com/legal/warranty</a> for details.	L19	LCD
	<ul style="list-style-type: none"> <li>Scratches</li> <li>Dents</li> </ul>				
	Does the computer exhibit this type of damage?	No	Go to step 11.	`\${nodeText.noSymptomCode}`	

	Check	Result	Action	Code	Commodity
11.	Closely examine the user's computer display assembly for signs of liquid spill damage.	Yes	Proceed with repair creation to see available options. Inform the user that computer failures due to accidental damage are not covered by Apple's one-year limited warranty or the AppleCare Protection Plan (APP).  Refer to <a href="http://www.apple.com/legal/warranty">www.apple.com/legal/warranty</a> for details.	L90	LCD
	Look for any signs of liquid spill, liquid penetration, or liquid damage to the computer's display assembly.				
	Does the computer exhibit this type of damage?	No	Go to step 12.	\${nodeText.noSymptomCode}	
12.	Closely examine the user's computer keyboard and top case for signs of cosmetic damage such as:	Yes	Proceed with repair creation to see available options. Inform the user that computer failures due to accidental damage are not covered by Apple's one-year limited warranty or the AppleCare Protection Plan (APP).  Refer to <a href="http://www.apple.com/legal/warranty">www.apple.com/legal/warranty</a> for details.	K21	KEYBOARD
	<ul style="list-style-type: none"> <li>Scratches</li> <li>Dents</li> </ul>				
	Does the computer exhibit this type of damage?	No	Go to step 13.	\${nodeText.noSymptomCode}	
13.	Closely examine the user's computer keyboard and top case for signs of cosmetic damage such as:	Yes	Proceed with repair creation to see available options. Inform the user that computer failures due to accidental damage are not covered by Apple's one-year limited warranty or the AppleCare Protection Plan (APP).  Refer to <a href="http://www.apple.com/legal/warranty">www.apple.com/legal/warranty</a> for details.	K35	KEYBOARD
	<ul style="list-style-type: none"> <li>Paint is wearing off of one or more keys on the built-in keyboard.</li> </ul>				
	Does the computer exhibit this type of damage?	No	Go to step 14.	\${nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
14.	Closely examine the user's computer keyboard and top case for signs of liquid spill damage.	Yes	Proceed with repair creation to see available options. Inform the user that computer failures due to accidental damage are not covered by Apple's one-year limited warranty or the AppleCare Protection Plan (APP).  Refer to <a href="http://www.apple.com/legal/warranty">www.apple.com/legal/warranty</a> for details.	K90	KEYBOARD
	Look for any signs of liquid spill, liquid penetration, or liquid damage to the computer's keyboard and top case.  Does the computer exhibit this type of damage?	No	Go to step 15.	`\${nodeText.noSymptomCode}`	
15.	Closely examine the user's AC power adapter for signs of connector damage such as: <ul style="list-style-type: none"> <li>• Pins stuck, broken, burnt, pushed in, or bent.</li> </ul>	Yes	Proceed with repair creation to see available options. Inform the user that computer failures due to accidental damage are not covered by Apple's one-year limited warranty or the AppleCare Protection Plan (APP).  Refer to <a href="https://www.apple.com/legal/warranty">https://www.apple.com/legal/warranty</a> for details.	P15	ADAPTER
	Does the AC power adapter exhibit this type of damage?	No	Go to step 16.	`\${nodeText.noSymptomCode}`	
16.	Closely examine the user's AC power adapter for signs of mechanical damage such as: <ul style="list-style-type: none"> <li>• Adapter connector or cable</li> <li>• Adapter housing</li> </ul>	Yes	Proceed with repair creation to see available options. Inform the user that computer failures due to accidental damage are not covered by Apple's one-year limited warranty or the AppleCare Protection Plan (APP).  Refer to <a href="http://www.apple.com/legal/warranty">www.apple.com/legal/warranty</a> for details.	P16	ADAPTER
	Does the AC power adapter exhibit this type of damage?	No	Go to step 17.	`\${nodeText.noSymptomCode}`	

	Check	Result	Action	Code	Commodity
17.	<p>Closely examine the user's AC power adapter for signs of cosmetic damage such as:</p> <ul style="list-style-type: none"> <li>Scratches</li> <li>Dents</li> </ul>	Yes	<p>Proceed with repair creation to see available options. Inform the user that computer failures due to accidental damage are not covered by Apple's one-year limited warranty or the AppleCare Protection Plan (APP).</p> <p>Refer to <a href="http://www.apple.com/legal/warranty">www.apple.com/legal/warranty</a> for details.</p>	P21	ADAPTER
	Does the AC power adapter exhibit this type of damage?	No	Go to step 18.	`\${nodeText.noSymptomCode}`	
18.	<p>Closely examine the user's AC power adapter for signs of liquid spill damage.</p> <p>Look for any signs of liquid spill, liquid penetration, or liquid damage to the user's AC power adapter.</p>	Yes	<p>Proceed with repair creation to see available options. Inform the user that computer failures due to accidental damage are not covered by Apple's one-year limited warranty or the AppleCare Protection Plan (APP).</p> <p>Refer to <a href="http://www.apple.com/legal/warranty">www.apple.com/legal/warranty</a> for details.</p>	P90	ADAPTER
	Does the AC power adapter exhibit this type of damage?	No	Go to step 19.	`\${nodeText.noSymptomCode}`	
19.	<p>Closely examine the user's USB-C charge cable and connectors for damage.</p> <p>Refer to <a href="#">TP1520: Visual/Mechanical Inspection (VMI) Guide for Mac Portables USB-C Cables</a> when inspecting the user's cable.</p>	Yes	<p>Proceed with repair creation to see available options. Inform the user that computer failures due to accidental damage are not covered by Apple's one-year limited warranty or the AppleCare Protection Plan (APP).</p> <p>Refer to <a href="https://www.apple.com/legal/warranty">https://www.apple.com/legal/warranty</a> for details.</p>	X03	EXTERNAL CABLE
	Does the USB-C charge cable exhibit damage according to the VMI?	No	<p><b>ESCALATION REQUIRED.</b></p> <p>Contact CSS for assistance with Apple-related accidental damage.</p>	`\${nodeText.noSymptomCode}`	



# Noise, Hum, or Vibration

**Unlikely causes:**

**Likely Causes:** Fan, power adapter.

**Quick Check**

Symptoms	Quick Check
<ul style="list-style-type: none"><li>• Computer or power adapter emits noise or vibration.</li><li>• Excessive fan noise (some models only).</li></ul>	<p><b>Important:</b> Before performing any troubleshooting that requires disassembling the computer, ensure that you have installed the battery cover and disconnected the battery.</p> <p><b>Note:</b> Verify the issue after using the computer for a few minutes to warm it, or by following steps in <a href="#">HT207571: Warm a Mac for testing</a>. Doing this may help identify intermittent issues.</p> <ol style="list-style-type: none"><li>1. Work with user to reproduce issue and isolate source of noise. Determine whether source of noise is computer or power adapter.</li><li>2. If power adapter is source of noise, test with a known-good adapter. (A small amount of hum or vibration is normal for power adapters.)</li><li>3. If necessary, explain to user that some noises are normal. Refer to <a href="#">HT202179: About fans and fan noise in your Apple product</a>.</li><li>4. While connected to the user's power adapter and charging cable, run AST 2 Mac Resource Inspector diagnostic suite (MRI) to gather diagnostic information about the computer. MRI will report a failure if any sensors are not detected or are exceeding expected thermal values. An unreadable thermal sensor can cause a fan to run excessively. If MRI reports any thermal sensor failures, return to the list of symptoms and select "Computer Feels Unusually Warm or has Unusual Odors". Otherwise, continue troubleshooting.</li><li>5. Refer to <a href="#">TP1907: Common Troubleshooting Procedures for Mac Computers with Apple Silicon</a> before performing further troubleshooting.</li></ol>

**Deep Dive**

	Check	Result	Action	Code	Commodity
1.	Shut down the computer and let it cool off fully. Once the computer is cold, start it up and check for noise, hum, or vibration.	Yes	Go to step 2.	`\${nodeText.yesSymptomCode}`	
		No	Go to step 8.	`\${nodeText.noSymptomCode}`	
	Does issue persist during cold startup?				

	Check	Result	Action	Code	Commodity
2.	<p>A disconnected or malfunctioning fan will prevent proper cooling and may cause thermal sensors to exceed expected values. An obstructed fan or heat sink may also cause excessive fan noise.</p> <p>Check diagnostic results for fan motor failures.</p> <p><b>Note:</b> Some computer models do not have a fan. Reply 'NO' to skip this question and continue troubleshooting for models without a fan.</p> <p>Did diagnostics report any fan motor test failure?</p>	Yes	Go to step 3.	\${nodeText.yesSymptomCode}	
		No	Go to step 8.	\${nodeText.noSymptomCode}	
3.	<p>Follow Service Guide procedures to remove the bottom case and disconnect the battery from the logic board.</p> <p>Disconnect and inspect the fan flex cable and its connectors, looking for connector or cable damage.</p> <p>Also check for damage on the logic board fan flex connectors.</p> <p>Did you find damage to this flex cable or any connectors?</p>	Yes	Go to step 4.	\${nodeText.yesSymptomCode}	
		No	Go to step 5.	\${nodeText.noSymptomCode}	
4.	<p>Determine whether the damage is located on the flex cable, or other parts.</p> <p>Is the damage limited to the flex cable?</p>	Yes	<p>Replace the fan.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	X23	OTHER ELECTRIC
		No	<p><b>ESCALATION REQUIRED.</b></p> <p>Contact CSS for additional support or a multipart repair.</p>	\${nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
5.	With fan disconnected, briefly retest for noise, hum, or vibration.  Has noise been eliminated?	Yes	Replace the fan.  Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.  Verify that the issue is resolved.	X23	OTHER ELECTRIC
		No	Go to step 6.	\$(nodeText.noSymptomCode)	
6.	Carefully reseal the fan flex cable into its connector.	Yes	Go to step 7.	\$(nodeText.yesSymptomCode)	
	Reassemble the computer and run diagnostics again.  Do diagnostics still report a fan failure?	No	Issue resolved by resealing fan flex cable. Verify resolution.	\$(nodeText.noSymptomCode)	
7.	Remove the fan to reveal inner side of heat sink. Use an ESD-safe vacuum to remove dust and debris from heat sink and fan.  Reassemble the computer and run diagnostics again.  Do diagnostics still report a fan failure?	Yes	Replace the fan.  Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.  Verify that the issue is resolved.	X23	OTHER ELECTRIC
		No	Issue resolved by cleaning fan and heat sink. Verify resolution.	\$(nodeText.noSymptomCode)	
8.	Substitute a known-good compatible power adapter and retest.	Yes	Replace power adapter. Verify that the issue is resolved.	P04	ADAPTER
	Has noise been eliminated?	No	Go to step 9.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
9.	Disconnect any peripheral devices, cards, or cables attached to computer.  Has noise been eliminated?	Yes	Issue resolved.  Issue caused by ground loop induced by third-party devices. Advise user to connect all devices to a common power outlet or contact device manufacturer for support.	`\${nodeText.yesSymptomCode}`	
		No	Go to step 10.	`\${nodeText.noSymptomCode}`	
10.	Noise may be related to interference from other electrical devices operating near computer or plugged into same power outlet.  See if noise is eliminated when computer runs in a different location on a different circuit.  Has noise been eliminated?	Yes	Issue resolved. Verify resolution.	`\${nodeText.yesSymptomCode}`	
		No	<b>ESCALATION REQUIRED.</b>  Contact CSS for additional support or a multipart repair.	`\${nodeText.noSymptomCode}`	
11.	Verify that noise, hum, or vibration is resolved.  Use Cooling System Diagnostic to verify that the computer is running within thermal specifications.  Run AST 2 Post-Repair Diagnostic suite if available, to ensure no other issues remain.  Is the issue resolved?	Yes	The issue is resolved.	`\${nodeText.yesSymptomCode}`	
		No	<b>ESCALATION REQUIRED.</b>  Contact CSS for additional support or a multipart repair.	`\${nodeText.noSymptomCode}`	

# Battery and Power Adapter Issues

## Unlikely causes:

**Likely Causes:** AC wall adapter (duckhead), battery, I/O board, power adapter, power cord, top case assembly, USB-C charging cable.

## Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none"><li>• “X” in battery status menu.</li><li>• Battery menu displays messages such as Service Battery, Replace Now, or Replace Soon.</li><li>• Battery not charging.</li><li>• Battery runs out of power very quickly, or without any warning.</li><li>• No lightning bolt icon in battery status menu or power connection feedback when power adapter is connected.</li><li>• The computer does not start up from shutdown when the power adapter is attached.</li></ul>	<p><b>Important:</b> Before performing any troubleshooting that requires disassembling the computer, ensure that you have installed the battery cover and disconnected the battery.</p> <ol style="list-style-type: none"><li>1. Verify that applications or other software issues are not forcing the computer to consume battery power. Refer to <a href="#">HT203184: See how apps affect Mac performance, battery runtime, temperature, and fan activity</a>. To help extend battery performance, refer the user to <a href="#">HT204054: About Mac notebook batteries</a>.</li><li>2. Verify that the user’s power adapter and charging cable are the correct models for the user’s computer. Refer to <a href="#">HT201700: Find the right power adapter and cable for your Mac notebook</a>. Different power adapters and USB-C charging cables may appear similar but may not provide sufficient power to turn on or charge the computer.</li><li>3. Check for damage or debris in the USB-C connectors on the user’s computer, power adapter, AC wall adapter, and charging cable. Refer to <a href="#">TP1125: Visual/Mechanical Inspection (VMI) Guide for Power Adapters for Mac Portables</a> and <a href="#">TP1520: Visual/Mechanical Inspection (VMI) Guide for Mac Portables USB-C Cables</a>.</li><li>4. Connect the power adapter to each USB-C connector on the computer and retest each time to isolate a possible faulty USB-C port on the user’s computer.</li><li>5. If the battery is drained on the user’s computer, connect it to a known-good power adapter with a known-good charging cable and charge the computer for up to 10 minutes to verify that the computer’s battery can charge. If the user’s computer does not turn on with a known-good power adapter, return to the list of symptoms and select “No Power”.</li><li>6. Run AST 2 Power Adapter diagnostics with the user’s power adapter connected to a known-good computer to confirm that the power adapter is functioning.</li><li>7. Run AST 2 Power Adapter diagnostics with a known-good power adapter connected to the user’s computer to confirm that the computer is functioning.</li><li>8. <b>Important:</b> Check for and apply the latest software and firmware updates to the user’s computer. Retest for the user’s original issue before continuing with further troubleshooting. To determine if the user’s Mac needs updating, refer to <a href="#">HT201260: Find out which macOS your Mac is using</a>. To update macOS, refer to <a href="#">HT201541: How to update the software on your Mac</a>.</li></ol> <p>If an update is available, perform the update on the user’s computer and repeat this process until no further updates are available. Then retest for the user’s original issue before continuing with further troubleshooting.</p> <ol style="list-style-type: none"><li>9. Refer to <a href="#">TP1907: Common Troubleshooting Procedures for Mac Computers with Apple Silicon</a> before performing further troubleshooting.</li><li>10. Refer to the following articles to learn more about power-related features and functions specific to this computer that may be misinterpreted as service issues:<ul style="list-style-type: none"><li>• <a href="#">HT207097: Charge your MacBook Pro with Thunderbolt</a></li></ul></li></ol>

	<p>3</p> <ul style="list-style-type: none"> <li>• <a href="#">HT201150: How to turn your Mac on or off</a></li> <li>• <a href="#">HT204652: If your USB-C power adapter isn't charging your Mac notebook</a></li> <li>• <a href="#">HT204700: Battery may not charge or drains while using AC power</a></li> <li>• <a href="#">HT211246: If you see 'not charging' when your Mac notebook is connected to power</a></li> <li>• <a href="#">HT211832: About battery health management in Mac notebooks</a></li> <li>• <a href="#">HT201585: Determine battery cycle count for Mac notebooks</a></li> </ul>
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## Deep Dive

	Check	Result	Action	Code	Commodity
1.	Inspect all USB-C ports and top case openings on the user's computer for any signs of deformation, damage, or debris that may be blocking the connection. Use compressed air to clear any obstructions or debris.  <b>Important:</b> Do not use any metal objects to clear debris or obstructions, as this can short the connector and cause damage.  Is any USB-C port damaged?	Yes	Go to step 2.	<code>\${nodeText.yesSymptomCode}</code>	
		No	Go to step 3.	<code>\${nodeText.noSymptomCode}</code>	

	Check	Result	Action	Code	Commodity
2.	<p>Inspect the opening on the top case for the USB-C port. Determine whether the opening is misshapen or deformed, preventing proper insertion of the USB plugs.</p> <p>Is the opening for the USB-C port damaged or deformed?</p>	Yes	<p>Replace the top case assembly.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	K16	KEYBOARD
		No	<p>Replace the I/O board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	M24	OTHER BOARD
3.	<p>Connect the user's computer to a known-good Apple USB-C power adapter with a known-good Apple USB-C charging cable that is the correct type for the user's computer.</p> <p>Connect the power adapter to a known-good electrical outlet.</p> <p>Check that the computer recognizes the power adapter.</p> <p>The computer should turn on automatically if it is off when the power adapter is connected.</p> <p>Verify in System Information &gt; Power &gt; AC Charger Information that the computer recognizes the power adapter.</p> <p>Does the computer recognize the power adapter, turn on, and begin to charge?</p>	Yes	Go to step 4.	\${nodeText.yesSymptomCode}	
		No	Go to step 5.	\${nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
4.	Shut down the computer.	Yes	Go to step 6.	#{nodeText.yesSymptomCode}	
	<p>Disconnect and flip the orientation of the USB-C charging cable plug, then reconnect it to the same USB-C port on the computer and retest, to test both orientations.</p> <p>The computer should turn on automatically.</p> <p>Verify in System Information &gt; Power &gt; AC Charger Information that the computer recognizes the power adapter.</p> <p>Does the computer recognize the power adapter, turn on, and begin to charge?</p>	No	Go to step 5.	#{nodeText.noSymptomCode}	
5.	Follow Service Guide procedures to remove the bottom case and disconnect the battery from the logic board.	Yes	The issue was resolved by reseating the I/O board. Verify resolution.	#{nodeText.yesSymptomCode}	
	<p>Disconnect then reconnect the I/O board to reseat the connection to the logic board and reassemble the computer.</p> <p>Connect the user's computer to a known-good power adapter and charging cable that is connected to a known-good electrical outlet.</p> <p>The computer should turn on automatically if it is off when the power adapter is connected.</p> <p>Verify in System Information &gt; Power &gt; AC Charger Information that the computer recognizes the power adapter.</p> <p>Does the computer recognize the power adapter, turn on, and begin to charge?</p>	No	<p>Replace the I/O board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	M21	OTHER BOARD
6.	Substitute the user's power adapter and recheck System Information > Power > AC Charger Information to verify that the computer recognizes the user's power adapter.	Yes	Go to step 7.	#{nodeText.yesSymptomCode}	
	<p>Does the computer recognize the user's power adapter?</p>	No	Replace the power adapter. Verify that the issue is resolved.	P23	ADAPTER



	Check	Result	Action	Code	Commodity
7.	Run Power Adapter diagnostics suite.	Yes	Replace the power adapter. Verify that the issue is resolved.	P23	ADAPTER
	Power Adapter diagnostics suite may report a faulty power adapter, which could cause short battery runtimes.	No	Go to step 8.	`\${nodeText.noSymptomCode}`	
8.	Does Power Adapter diagnostics suite report a power adapter failure?				
	While connected to the user's power adapter and charging cable, run AST 2 Mac Resource Inspector diagnostic suite (MRI) to gather diagnostic information about the battery.	Yes	Go to step 9.	`\${nodeText.yesSymptomCode}`	
	Check MRI results for any battery-specific warnings or failures.	No	Go to step 10.	`\${nodeText.noSymptomCode}`	
	Does MRI report any battery errors?				
9.	Some notebook models have a replaceable battery and some models require replacement of the top case assembly. Refer to the Service Guide for more information.	Yes	Replace the battery.  Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.  Verify that the issue is resolved.	P09	BATTERY
		No	Replace the top case assembly.  Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.  Verify that the issue is resolved.	K41	KEYBOARD
	Is the battery replaceable in this model?				

	Check	Result	Action	Code	Commodity
10.	Substitute the user's charging cable with the known-good power adapter.	Yes	Go to step 11.	\${nodeText.yesSymptomCode}	
	Verify that the computer turns on and charges.  Does the computer recognize the user's USB-C charging cable?	No	Replace the USB-C charging cable. Verify that the issue is resolved.	X03	EXTERNAL CABLE
11.	Run AST 2 Power Adapter diagnostic suite on the user's computer with the user's power adapter and charging cable connected to confirm that the user's power adapter and charging cable are both functioning.	Yes	The issue cannot be duplicated.	\${nodeText.yesSymptomCode}	
	Does the computer pass all tests?	No	Go to step 12.	\${nodeText.noSymptomCode}	
12.	Substitute the user's AC wall adapter (duckhead) or power cord for a known-good AC wall adapter or power cord.	Yes	Replace the power cord or AC wall adapter (duckhead). Verify that the issue is resolved.	X03	EXTERNAL CABLE
	Retest with AST 2 Power Adapter diagnostics.  Does the computer pass all tests?	No	Go to step 13.	\${nodeText.noSymptomCode}	
13.	Substitute a known-good, compatible power adapter.	Yes	Replace the power adapter. Verify that the issue is resolved.	P23	ADAPTER
	Retest with AST 2 Power Adapter diagnostics.  Does the computer pass all tests?	No	Replace the USB-C charging cable. Verify that the issue is resolved.	X03	EXTERNAL CABLE
14.	Verify that the battery or power adapter issue is resolved.	Yes	The issue is resolved.	\${nodeText.yesSymptomCode}	
	Run AST 2 Post-Repair Diagnostic suite if available, to ensure no other issues remain.  Is the issue resolved?	No	<b>ESCALATION REQUIRED.</b>  Contact CSS for additional support or a multipart repair.	\${nodeText.noSymptomCode}	

# Intermittent Shutdown, Kernel Panic, or System Instability

## Unlikely causes:

**Likely Causes:** Logic board, battery.

## Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none"><li>• Computer shuts down during startup.</li><li>• Computer shuts down unexpectedly during use.</li><li>• Computer restarts and displays a kernel panic alert message.</li><li>• Computer freezes during use.</li><li>• Computer freezes upon wake from sleep.</li></ul>	<p><b>Important:</b> Before performing any troubleshooting that requires disassembling the computer, ensure that you have installed the battery cover and disconnected the battery.</p> <p><b>Note:</b> Verify the issue after using the computer for a few minutes to warm it, or by following steps in <a href="#">HT207571: Warm a Mac for testing</a>. Doing this may help identify intermittent issues.</p> <ol style="list-style-type: none"><li>1. Collect the following details from the user regarding shutdown occurrence and system configuration: when shutdown occurs (for example, on battery power or after running for a while), the frequency of shutdowns, which applications are running at the time, and shutdown repeatability.</li><li>2. Refer to <a href="#">HT200553: If your Mac restarted because of a problem</a>.</li><li>3. Attempt to start up in Safe Mode to verify that the computer can start up completely without any issues. Refer to <a href="#">HT201262: How to use safe mode on your Mac</a> for more information.</li><li>4. <b>Important:</b> Check for and apply the latest software and firmware updates to the user's computer. Retest for the user's original issue before continuing with further troubleshooting. To determine if the user's Mac needs updating, refer to <a href="#">HT201260: Find out which macOS your Mac is using</a>. To update macOS, refer to <a href="#">HT201541: How to update the software on your Mac</a>.  If an update is available, perform the update on the user's computer and repeat this process until no further updates are available. Then retest for the user's original issue before continuing with further troubleshooting.</li><li>5. While connected to the user's power adapter and charging cable, run AST 2 Mac Resource Inspector diagnostic suite (MRI) to gather diagnostic information about the computer. MRI will report a failure if any sensors are not detected or are exceeding expected thermal values. An unreadable thermal sensor can cause intermittent shutdowns.  Also run Cooling System Diagnostic suite (CSD). CSD works like a stress test on the computer, gathering information about the thermal performance while various components are under heavy use.  If MRI or CSD report any thermal sensor or fan failures, return to the list of symptoms and select "Computer Feels Unusually Warm or has Unusual Odors". Otherwise, continue troubleshooting.</li><li>6. Refer to <a href="#">TP1907: Common Troubleshooting Procedures for Mac Computers with Apple Silicon</a> before performing further troubleshooting.</li></ol>

## Deep Dive

	Check	Result	Action	Code	Commodity
1.	Power or thermal issues can cause intermittent shutdowns. Run AST 2 Mac Resource Inspector diagnostic suite (MRI) to check for problems detected by sensors and fans.	Yes	Go to step 4.	`\${nodeText.yesSymptomCode}`	
	<p>Identify the specific type of failure reported in MRI: Thermal sensor, fan failure, voltage or current sensor, or some other failure.</p> <p>There are three types of sensors that are used in the computer: voltage, current, and temperature. The sensor type is identified by the first letter in the sensor key.</p> <ul style="list-style-type: none"> <li>• Voltage sensor keys start with “V”</li> <li>• Current sensor keys start with “I”</li> <li>• Temperature sensor keys start with “T”</li> </ul> <p>If MRI reports any thermal sensor or fan failures, return to the list of symptoms and select “Computer Feels Unusually Warm or has Unusual Odors”.</p> <p>Does MRI report any voltage or current sensor errors?</p>	No	Go to step 2.	`\${nodeText.noSymptomCode}`	
2.	Run AST 2 Power Adapter diagnostic suite on the user’s computer.	Yes	Go to “Battery and Power Adapter Issues”.	`\${nodeText.yesSymptomCode}`	
	<p>MRI may report a consumed or defective battery. Power Adapter diagnostics may report a faulty power adapter.</p> <p>Either issue can cause intermittent shutdowns.</p> <p>Does MRI or Power Adapter diagnostic suite report a battery or power adapter failure?</p>	No	Go to step 3.	`\${nodeText.noSymptomCode}`	

	Check	Result	Action	Code	Commodity
3.	Run AST 2 Full System Diagnostic suite and check whether the computer unexpectedly shuts down.  Is the shutdown event reproducible?	Yes	Replace the logic board and Touch ID board.  Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.  Verify that the issue is resolved.	M8	MLB
		No	The issue cannot be duplicated.	\${nodeText.noSymptomCode}	
4.	Check diagnostic results for battery current or voltage sensor errors.  Did diagnostics report any battery current or voltage sensor errors?	Yes	Go to step 5.	\${nodeText.yesSymptomCode}	
		No	Go to step 6.	\${nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
5.	<p>Some notebook models have a replaceable battery and some models require replacement of the top case assembly. Refer to the Service Guide for more information.</p> <p>Is the battery replaceable in this model?</p>	Yes	<p>Replace the battery.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	P19	BATTERY
		No	<p>Replace the top case assembly.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	K41	KEYBOARD

	Check	Result	Action	Code	Commodity
6.	<p>Check diagnostic results for logic board current or voltage sensor errors.</p> <p>Did diagnostics report any logic board current or voltage sensor errors?</p>	Yes	<p>Replace the logic board and Touch ID board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	M23	MLB
		No	<p><b>ESCALATION REQUIRED.</b></p> <p>Contact CSS for additional support or a multipart repair.</p>	\${nodeText.noSymptomCode}	
7.	<p>Verify that the computer no longer unexpectedly shuts down or kernel panics.</p> <p>Run AST 2 Post-Repair Diagnostic suite if available, to ensure no other issues remain.</p> <p>Is the issue resolved?</p>	Yes	The issue is resolved.	\${nodeText.yesSymptomCode}	
		No	<p><b>ESCALATION REQUIRED.</b></p> <p>Contact CSS for additional support or a multipart repair.</p>	\${nodeText.noSymptomCode}	

# Startup Issues

## Unlikely causes:

**Likely Causes:** Logic board.

## Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none"><li>The computer does not start up completely when it is turned on.</li><li>The computer displays an exclamation point (!) with a circle around it.</li></ul>	<p><b>Important:</b> Before performing any troubleshooting that requires disassembling the computer, ensure that you have installed the battery cover and disconnected the battery.</p> <ol style="list-style-type: none"><li>Disconnect all peripherals.</li><li>Determine whether the computer has power by confirming that any of the following function correctly:<ul style="list-style-type: none"><li>Fan spins (some models only).</li><li>Trackpad clicks when pressed.</li><li>Power connection feedback occurs.</li><li>The built-in display functions.</li><li>A connected external display functions.</li></ul></li></ol> <p>If the user's computer shows no signs of power, return to the list of symptoms and select "No Power".</p> <ol style="list-style-type: none"><li>Determine whether the computer is in DFU mode. Press and hold the power button for 10 seconds to attempt to shut down the computer. Then press the power button again to attempt to turn on the computer. If the computer turns on, then it was in DFU mode and has power.</li><li>Refer to <a href="#">HT204267: If your Mac doesn't turn on</a> and <a href="#">HT211873: If your Mac starts up to a dark screen with 'Options'</a>.</li><li>Attempt to start up in Safe Mode to verify that the computer can start up completely without any issues. Refer to <a href="#">HT201262: How to use safe mode on your Mac</a> for more information.</li><li>If the user's Mac cannot start up to macOS and also cannot start up to macOS Recovery, an exclamation point with a circle around it is displayed. If you see this symbol when attempting to start up the user's computer, follow recommended steps in <a href="#">HT204156: If your Mac doesn't start up all the way</a>.</li><li>Refer to <a href="#">HT204463: If the fans in your Mac run at full speed when you turn it on</a>.</li><li>Connect the user's computer to a known-good compatible power adapter with a known-good charging cable and charge the computer for up to 10 minutes to verify that the computer's battery can charge. If the user's computer does not charge with a known-good power adapter, return to the list of symptoms and select the "No Power" troubleshooting flow.</li><li>Refer to <a href="#">TP1907: Common Troubleshooting Procedures for Mac Computers with Apple Silicon</a> before performing further troubleshooting.</li></ol>

## Deep Dive



	Check	Result	Action	Code	Commodity
1.	Connect a known-good compatible external display to the user's computer.	Yes	Go to step 2.	`\${nodeText.yesSymptomCode}`	
	<p>Connect the user's computer to the user's power adapter and charging cable that is connected to a known-good electrical outlet.</p> <p>The computer should turn on automatically if it is off when the power adapter is connected.</p> <p>First check for an image on the built-in display.</p> <p>Is an image visible on the built-in display?</p>	No	Go to "Display Functional Issues".	`\${nodeText.noSymptomCode}`	
2.	Restart the computer and verify that it completes the startup process.	Yes	The issue cannot be duplicated.	`\${nodeText.yesSymptomCode}`	
	Does the computer complete the startup process?	No	Go to step 3.	`\${nodeText.noSymptomCode}`	
3.	Verify that the computer is turned off, then press and hold the power button for 10 seconds. Select macOS Recovery from Startup Options to start up into macOS Recovery. See <a href="#">HT201314: About macOS Recovery</a> .	Yes	Go to step 5.	`\${nodeText.yesSymptomCode}`	
	<p>Verify that the computer starts up to macOS Recovery.</p> <p>Does the computer start up to macOS Recovery?</p>	No	Go to step 4.	`\${nodeText.noSymptomCode}`	
4.	Revive the computer using <a href="#">Apple Configurator 2 User Guide</a> and a host Mac.	Yes	The issue was resolved by reviving the computer. Verify resolution.	`\${nodeText.yesSymptomCode}`	
	<p><b>Important:</b> Always ask if the user's data has been backed up first.</p> <p>Restart the computer and verify that it completes the startup process.</p> <p>Does the computer complete the startup process?</p>	No	Go to step 8.	`\${nodeText.noSymptomCode}`	

	Check	Result	Action	Code	Commodity
5.	Restart the computer and run AST 2 Full System Diagnostic suite on the computer.  Check diagnostic results for any failures.  Does the computer pass all tests?	Yes	Go to step 6.	`\${nodeText.yesSymptomCode}`	MLB
		No	Replace the logic board and Touch ID board.  Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.  Verify that the issue is resolved.	M02	
6.	Restart the computer to macOS Recovery.  Use Disk Utility to verify the computer's internal startup volume.  If errors are seen, use Disk Utility to repair the computer's internal startup volume.  Restart the computer and verify that it completes the startup process.  Does the computer complete the startup process?	Yes	The issue was resolved by repairing the startup volume using Disk Utility. Verify resolution.	`\${nodeText.yesSymptomCode}`	
		No	Go to step 7.	`\${nodeText.noSymptomCode}`	
7.	Start up the computer to macOS Recovery.  Use the 'Install macOS' option to update or reinstall macOS.  <b>Important:</b> Always ask if the user's data has been backed up first.  Restart the computer and verify that it completes the startup process.  Does the computer complete the startup process?	Yes	The issue was resolved by updating or reinstalling macOS. Verify resolution.	`\${nodeText.yesSymptomCode}`	
		No	Go to step 8.	`\${nodeText.noSymptomCode}`	

	Check	Result	Action	Code	Commodity
8.	Restore the computer using using <a href="#">Apple Configurator 2 User Guide</a> and a host Mac.	Yes	The issue was resolved by restoring the computer. Verify resolution.	`\${nodeText.yesSymptomCode}`	
	<p><b>Important:</b> Always ask if the user's data has been backed up first. The restore process will delete all user data and reinstall a new macOS and macOS Recovery.</p> <p>Restart the computer and verify that it completes the startup process.</p> <p>Does the computer complete the startup process?</p>	No	Go to step 9.	`\${nodeText.noSymptomCode}`	
9.	Follow Service Guide procedures to remove the bottom case and disconnect the battery from the logic board.	Yes	<p><b>ESCALATION REQUIRED.</b></p> <p>Contact CSS for additional support or a multipart repair.</p>	`\${nodeText.yesSymptomCode}`	
	<p>Inspect all internal cables and connectors for damage.</p> <p>Are any internal cables or connectors damaged?</p>	No	Go to step 10.	`\${nodeText.noSymptomCode}`	
10.	<p>Reseat the internal connections and reassemble the computer.</p> <p>Restart the computer and verify that it completes the startup process.</p> <p>Does the computer complete the startup process?</p>	Yes	The issue was resolved by reseating the internal connections. Verify resolution.	`\${nodeText.yesSymptomCode}`	
		No	<p>Replace the logic board and Touch ID board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	M02	MLB

	Check	Result	Action	Code	Commodity
11.	<p>Verify that the computer can now complete the startup process over multiple trials.</p> <p>Run AST 2 Post-Repair Diagnostic suite if available, to ensure no other issues remain.</p> <p>Is the issue resolved?</p>	Yes	The issue is resolved.	\${nodeText.yesSymptomCode}	
		No	<p><b>ESCALATION REQUIRED.</b></p> <p>Contact CSS for additional support or a multipart repair.</p>	\${nodeText.noSymptomCode}	

# No Power

## Unlikely causes:

**Likely Causes:** AC wall adapter (duckhead), battery, I/O board, logic board, power cord, power adapter, top case assembly, USB-C charging cable.

## Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none"><li>The computer does not turn on when the display is opened.</li><li>The computer does not turn on when the power button is pressed.</li><li>The computer does not turn on when the power adapter is connected.</li><li>The computer does not turn on when any keyboard key is pressed while the display is open.</li><li>The computer does not turn on when the trackpad is pressed while the display is open.</li><li>No image appears on the built-in display.</li></ul>	<p><b>Important:</b> Before performing any troubleshooting that requires disassembling the computer, ensure that you have installed the battery cover and disconnected the battery.</p> <ol style="list-style-type: none"><li>Disconnect all peripherals.</li><li>Determine whether the computer has power by confirming that any of the following function correctly:<ul style="list-style-type: none"><li>Fan spins (some models only).</li><li>Trackpad clicks when pressed.</li><li>Power connection feedback occurs.</li><li>The built-in display functions.</li><li>A connected external display functions.</li></ul></li><li>Determine whether the computer is in DFU mode. Press and hold the power button for 10 seconds to attempt to shut down the computer. Then press the power button again to attempt to turn on the computer. If the computer turns on, then it was in DFU mode and has power.</li><li>Refer to <a href="#">HT204267: If your Mac doesn't turn on</a>.</li><li>Verify that the user's power adapter and charging cable are the correct models for the user's computer. Refer to <a href="#">HT201700: Find the right power adapter and cable for your Mac notebook</a>. Different power adapters and USB-C charging cables may appear similar but may not provide sufficient power to turn on or charge the computer.</li><li>Check for damage or debris in the USB-C connectors on the user's computer, power adapter, AC wall adapter, and charging cable. Refer to <a href="#">TP1125: Visual/Mechanical Inspection (VMI) Guide for Mac Notebook Power Adapters</a> and <a href="#">TP1520: Visual/Mechanical Inspection (VMI) Guide for Mac Notebook USB-C Cables</a>.</li><li>Connect the power adapter to each USB-C connector on the computer and retest each time to isolate a possible faulty USB-C port on the user's computer.</li><li>Connect the user's computer to a known-good compatible power adapter with a known-good charging cable and charge the computer for up to 10 minutes to verify that the computer's battery can charge.</li><li>Run AST 2 Power Adapter diagnostics with the user's power adapter connected to a known-good computer to confirm that the power adapter is functioning.</li><li>Refer to <a href="#">TP1907: Common Troubleshooting Procedures for Mac Computers with Apple Silicon</a> before performing further troubleshooting.</li></ol>

## Deep Dive

	Check	Result	Action	Code	Commodity
1.	Connect a known-good compatible external display to the user's computer.	Yes	Go to step 2.	`\${nodeText.yesSymptomCode}`	
	Connect the user's computer to the user's power adapter and charging cable that is connected to a known-good electrical outlet.				
	The computer should turn on automatically if it is off when the power adapter is connected.	No	Go to step 3.	`\${nodeText.noSymptomCode}`	
	First check for an image on the built-in display.				
2.	Is an image clearly visible on the built-in display?				
	Restart the user's computer and verify that it completes the startup process.	Yes	The issue cannot be duplicated.	`\${nodeText.yesSymptomCode}`	
	Does the computer complete the startup process?	No	Go to "Startup Issues".	`\${nodeText.noSymptomCode}`	
3.	Next, check for an image on the connected external display.	Yes	Go to "Display Functional Issues".	`\${nodeText.yesSymptomCode}`	
	Is an image clearly visible on the connected external display?	No	Go to step 4.	`\${nodeText.noSymptomCode}`	
4.	Verify that the computer is turned off, then press and hold the power button for 10 seconds. Select macOS Recovery from Startup Options to start up into macOS Recovery. See <a href="#">HT201314: About macOS Recovery</a> .	Yes	The issue cannot be duplicated.	`\${nodeText.yesSymptomCode}`	
	Verify that the computer starts up to macOS Recovery.	No	Go to step 5.	`\${nodeText.noSymptomCode}`	
	Does the computer start up to macOS Recovery?				
5.	Inspect all USB-C ports and top case openings on the user's computer for any signs of deformation, damage, or debris that may be blocking the connection. Use compressed air to clear any obstructions or debris.	Yes	Go to step 6.	`\${nodeText.yesSymptomCode}`	
	<b>Important:</b> Do not use any metal objects to clear debris or obstructions, as this can short the connector and cause damage.	No	Go to step 7.	`\${nodeText.noSymptomCode}`	
	Is any USB-C port damaged?				

	Check	Result	Action	Code	Commodity
6.	<p>Inspect the opening on the top case for the USB-C port. Determine whether the opening is misshapen or deformed, preventing proper insertion of the USB plugs.</p> <p>Is the opening for the USB-C port damaged or deformed?</p>	Yes	<p>Replace the top case assembly.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	K16	KEYBOARD
		No	<p>Replace the I/O board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	M24	OTHER BOARD
7.	<p>Substitute the user's AC wall adapter (duckhead) or power cord for a known-good AC wall adapter or power cord.</p> <p>Attempt normal startup again.</p>	Yes	<p>Replace the power cord or AC wall adapter (duckhead). Verify that the issue is resolved.</p>	X03	EXTERNAL CABLE
	Does the computer turn on with a known-good AC wall adapter or power cord?	No	Go to step 8.	`\${nodeText.noSymptomCode}`	
8.	<p>Substitute a known-good, compatible power adapter.</p> <p>Attempt normal startup again.</p>	Yes	<p>Replace the power adapter. Verify that the issue is resolved.</p>	P23	ADAPTER
	Does the computer turn on with a known-good power adapter?	No	Go to step 9.	`\${nodeText.noSymptomCode}`	
9.	<p>Substitute a known-good, USB-C charging cable that is the correct type for the user's computer.</p> <p>Attempt normal startup again.</p>	Yes	<p>Replace the USB-C charging cable. Verify that the issue is resolved.</p>	X03	EXTERNAL CABLE
	Does the computer turn on with a known-good charging cable?	No	Go to step 10.	`\${nodeText.noSymptomCode}`	

	Check	Result	Action	Code	Commodity
10.	<p>Unplug the charging cable from the computer.</p> <p>Follow service guide procedures to remove the bottom case and disconnect the battery from the logic board.</p> <p>Connect the charging cable to the computer.</p> <p>Attempt normal startup again.</p> <p>Does the computer turn on when the battery is disconnected?</p>	Yes	Go to step 11.	\${nodeText.yesSymptomCode}	
		No	<p>Replace the logic board and Touch ID board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	M01	MLB
11.	<p>Some notebook models have a replaceable battery and some models require replacement of the top case assembly. Refer to the Service Guide for more information.</p> <p>Is the battery replaceable in this model?</p>	Yes	<p>Replace the battery.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	P19	BATTERY
		No	<p>Replace the top case assembly.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	K20	KEYBOARD



	Check	Result	Action	Code	Commodity
12.	Verify that the computer can now turn on and complete the startup process over multiple trials.	Yes	The issue is resolved.	`\${nodeText.yesSymptomCode}`	
		No	<b>ESCALATION REQUIRED.</b>  Contact CSS for additional support or a multipart repair.	`\${nodeText.noSymptomCode}`	
	Run AST 2 Post-Repair Diagnostic suite if available, to ensure no other issues remain.				
	Is the issue resolved?				

# MacBook Air (M1, 2020) Connector Types on the Logic Board

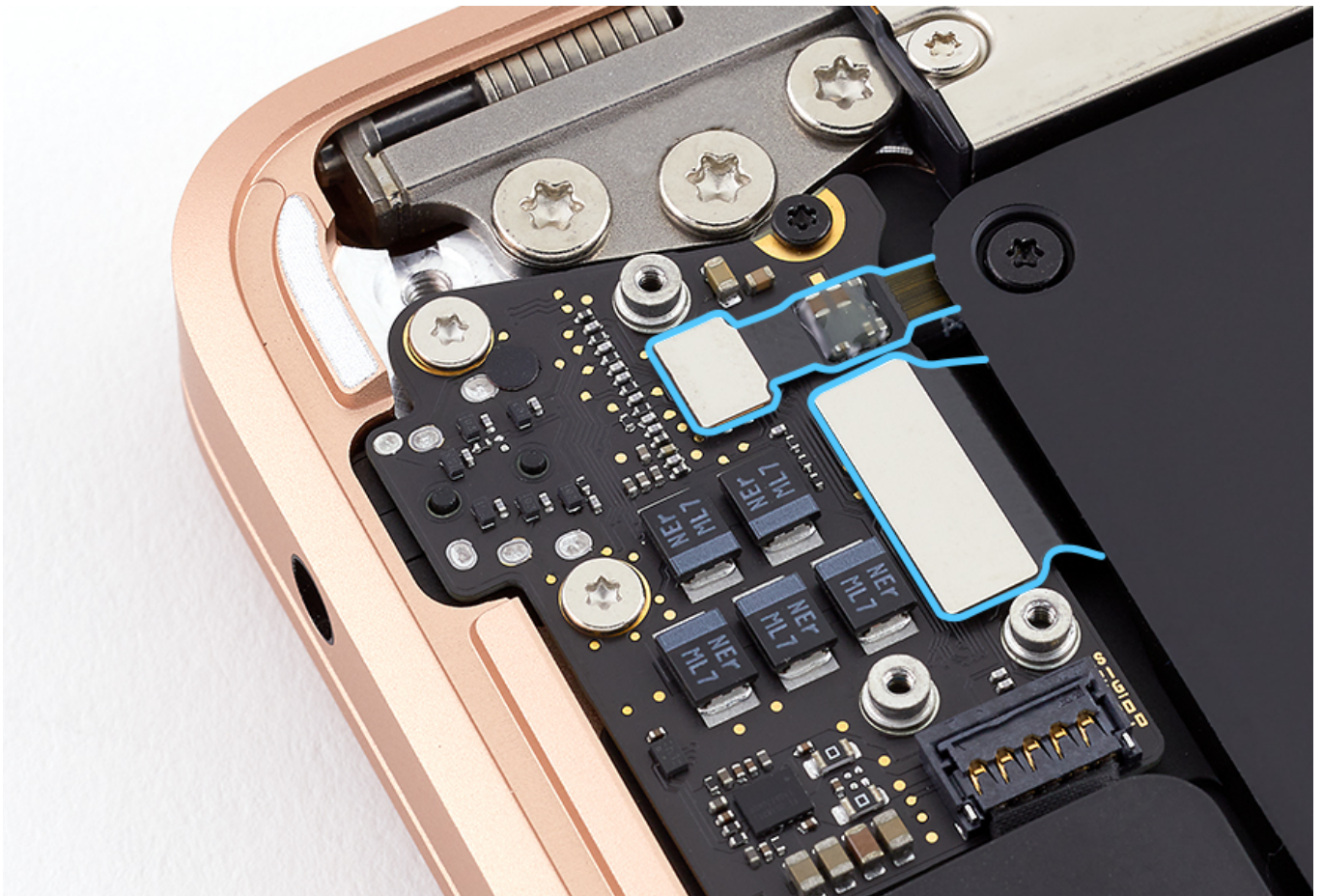
## Connector Types on the Logic Board for MacBook Air (M1, 2020)

This article discusses how to disconnect and connect the various types of connectors in this model of computer and provides examples of each connector type.

**Caution:** Do not disconnect or reconnect cables while the computer has power.

### Low-Profile Solid Platform Flex

- Remove and insert the cable vertically. The pins on the connectors can be bent if they are not inserted carefully and correctly.
- To reconnect the cable, keep the connector level to the board and press down evenly.
- Examples:
  - Input device (IPD) flex connector to logic board
  - I/O board flex connector
  - Audio Board flex connector
  - Touch ID flex connector
  - eDP flex connector



### Lock Bar

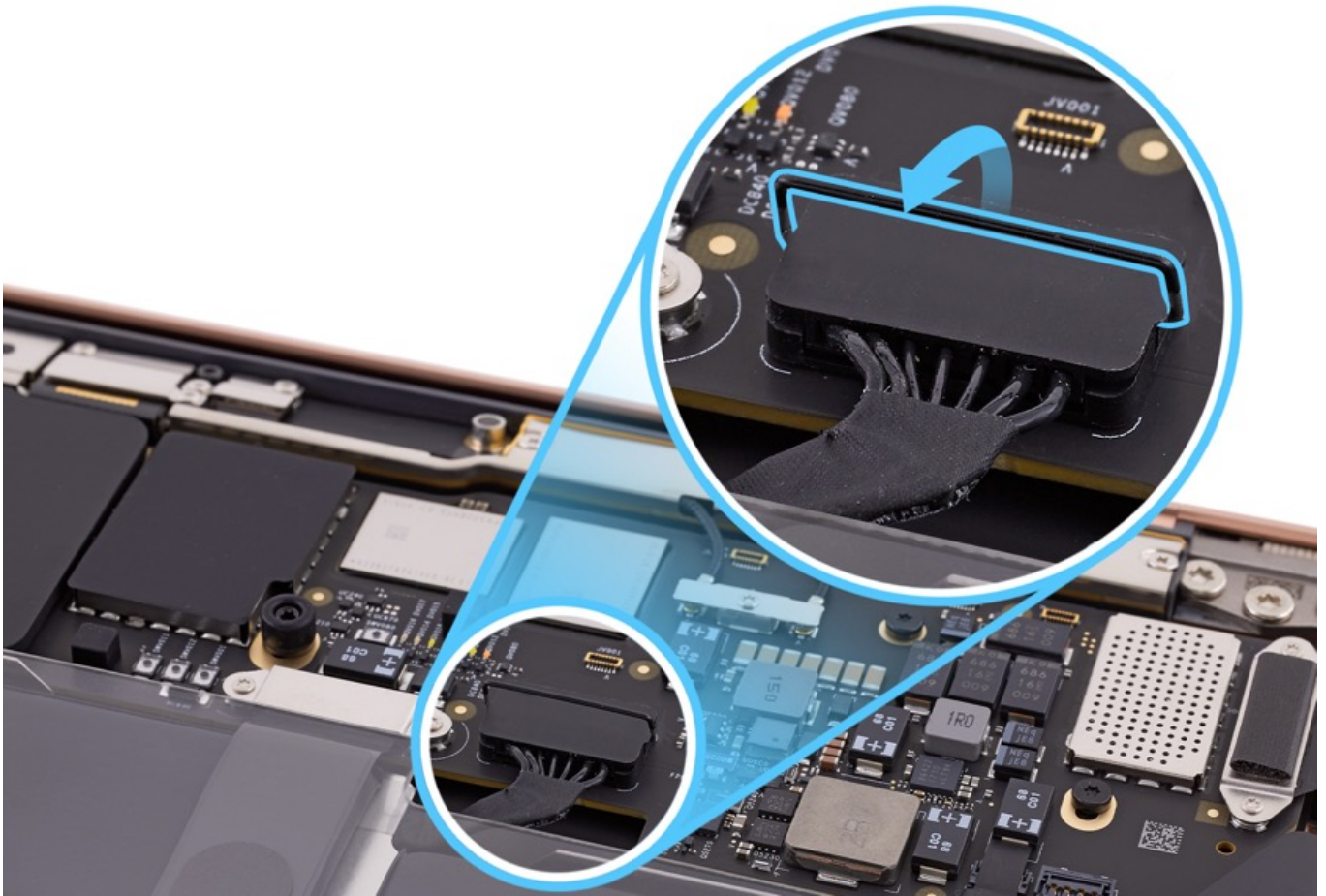


#### Caution:

- With a black stick, flip the lock bar up to a 90-degree angle for cable removal. Do not use the lock bar as a handle to disconnect the connector.
- Use a black stick to disconnect the connector.
- When reconnecting the battery, make sure the lock bar is above the connector, not below it. If the bar is trapped

underneath the connector when you apply pressure, it could damage either the bar or the connector pins on the logic board, leading to a logic board replacement.

- Lock down the lock bar all the way after inserting the cable.
- Example:
  - Battery flex connector



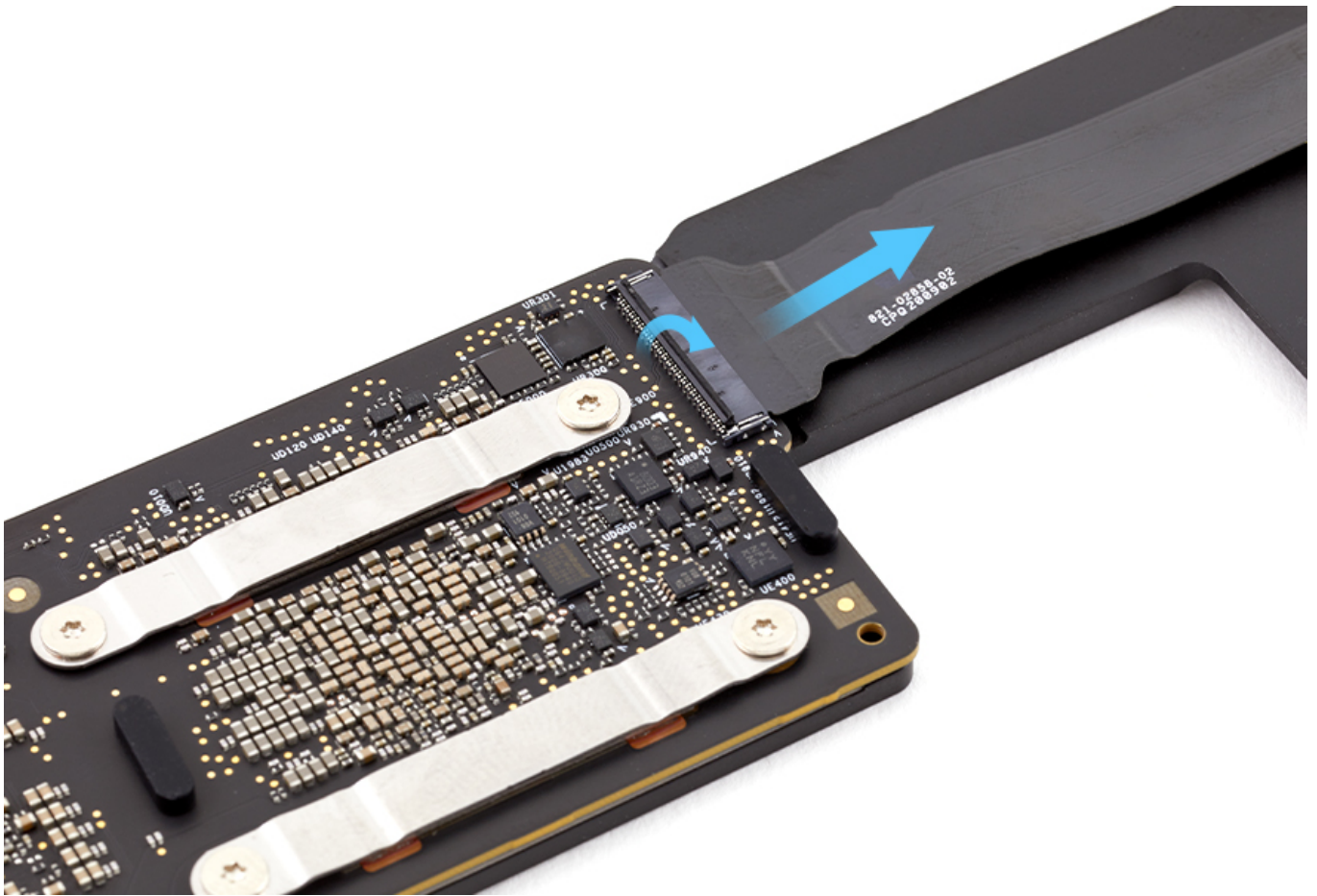
## Locking Lever

Example:

- Flip the lever up to a 90-degree angle for cable removal.
- Slide the cable into the receptacle on the same horizontal plane as the logic board.
- Lock down the lever after inserting the cable.
- Open the lever when handling or shipping a logic board module, whether it is a known-good or a known-bad board.
  - Audio flex connector
  - Microphone flex connector



**Caution:** The locking levers on the logic board are fragile. To protect the levers during handling or shipment of the logic board, always leave the the levers open after the cables are removed. Once the logic board is installed in the top case and the cables are connected, be sure to lock down the levers again.

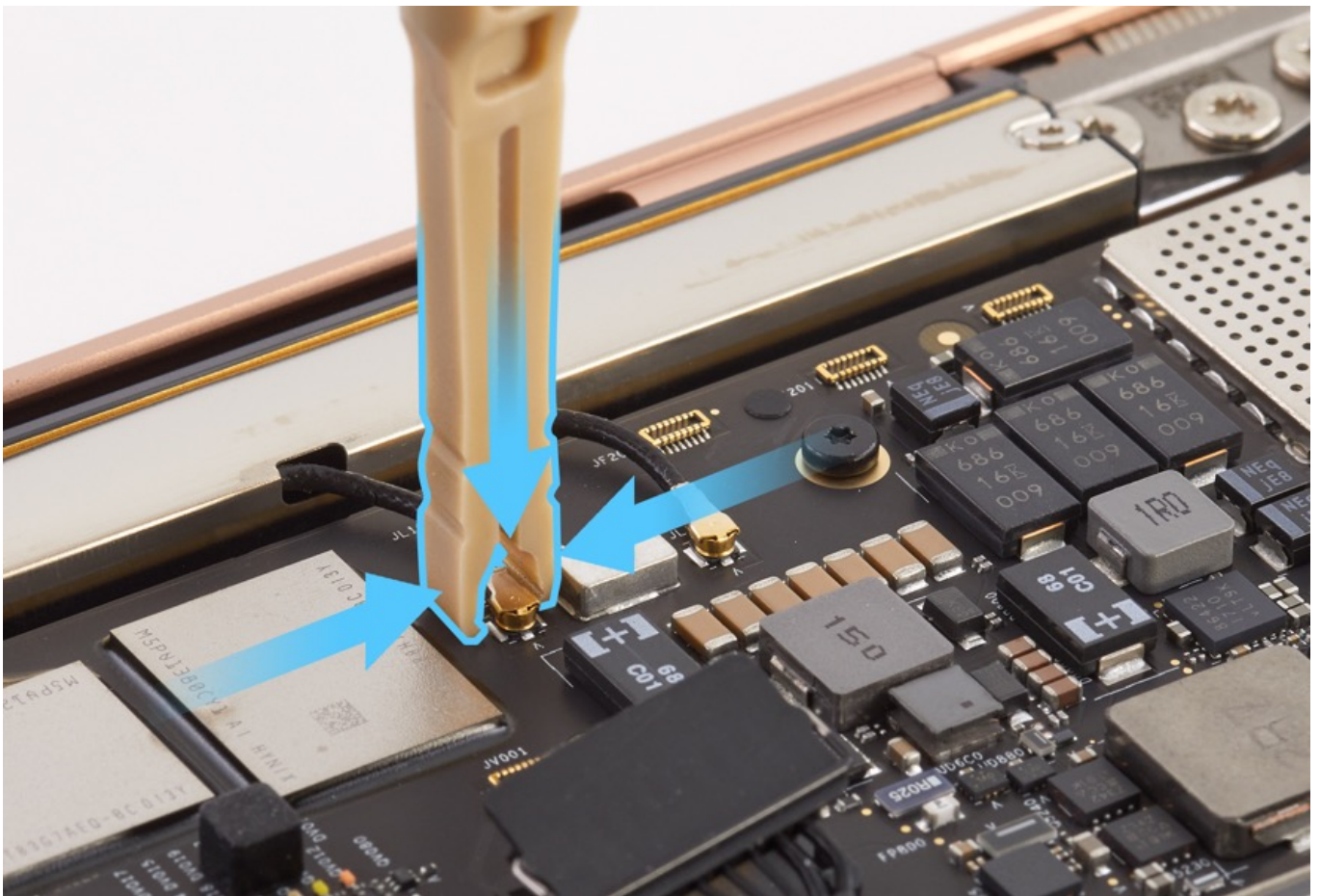


### Wireless Antenna Connectors

Example:

- The gold connectors are fragile, so handle them with care.
- To disconnect, grasp the connector head with the antenna tool.
- Lift straight up from the receptacle.
  - Wireless antennas

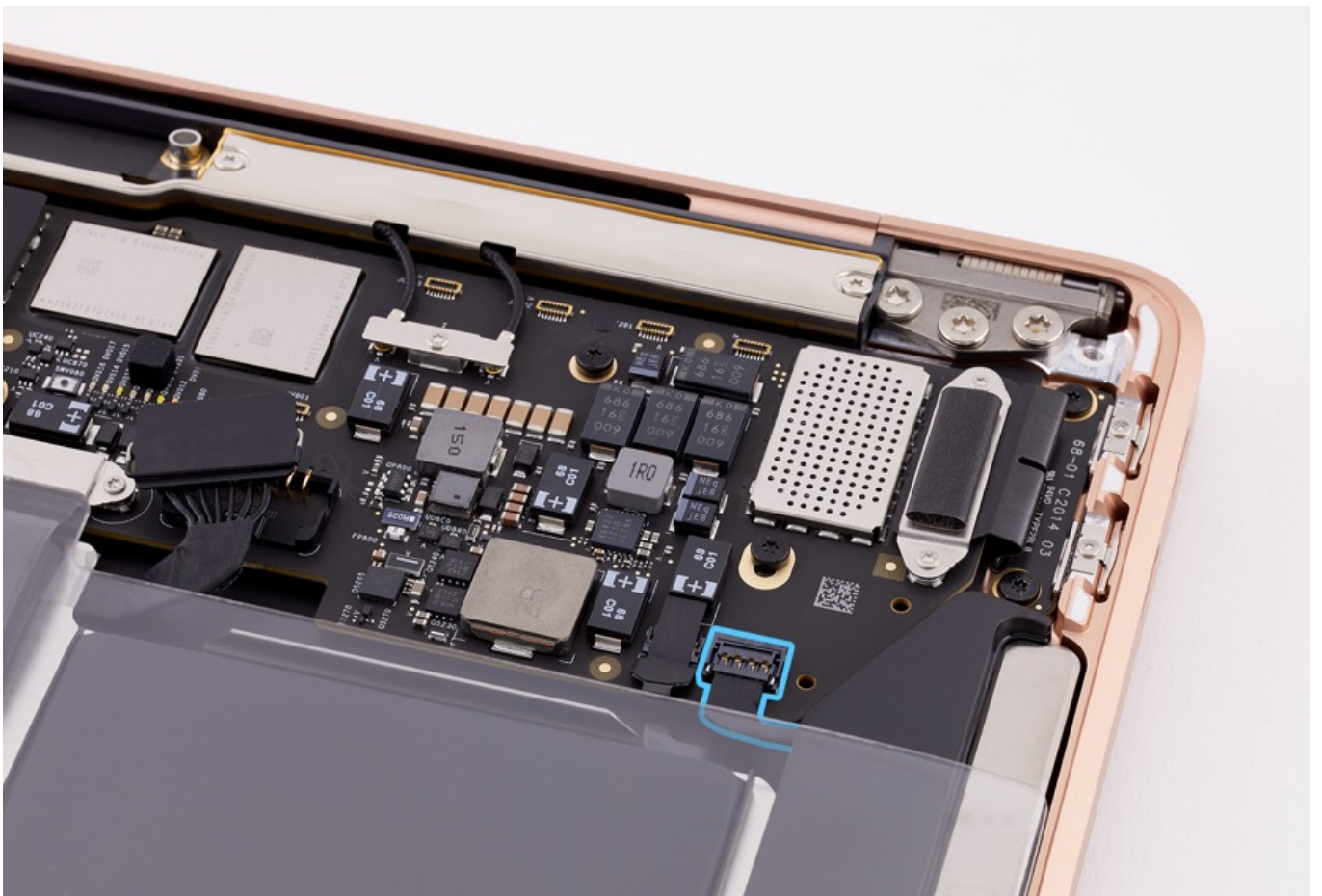




### Vertical Insertion (JST)

Below is an example of how to disconnect and reconnect a vertical insertion connector:

- Use a black stick under the cable to remove.
- Keep the connector level to the board when disconnecting and reconnecting.
- Press evenly when reconnecting or connector can be tipped up and not fully seated.
  - Right speaker flex cable
  - Left speaker flex cable



# MacBook Air (Retina, 13-inch, 2018, 2019, and 2020) and MacBook Air (M1, 2020) Tools and Fixtures

## Tools and Fixtures for MacBook Air (Retina, 13-inch, 2018, 2019, and 2020) and MacBook Air (M1, 2020)

**Caution:** To prevent scratches or other cosmetic damage to the computer housing, use a soft cloth as a protective layer when removing and installing the external screws.

The following tools are required:

- Clean, soft, lint-free cloth
- ESD-safe workstation, including an ESD mat and wrist or heel strap
- ESD bags (for storing ESD-sensitive parts while removed from the unit)
- Pentalobe screwdriver (923-0731)
- Torx T3 screwdriver (magnetized)
- Torx T5 screwdriver (magnetized)
- Torx T8 screwdriver (magnetized)
- Torque driver, adjustable, 10–34 Ncm (923-02995)
- T5 Bit, 1/4-inch hex, 25 mm (923-02996)
- Torque driver, adjustable, 0.3–1.2 Nm (923-0735)
- Black stick (nylon probe, 922-5065) or other nonconductive nylon or plastic flat-blade tool
- Flat-nosed, ESD-safe tweezers
- Antenna tool (923-01322)
- Ultraviolet Flashlight (923-01604)
- Battery and speaker adhesive (076-00411)
- Battery and speaker adhesive (076-00467) for MacBook Air (Retina, 13-inch, 2020)
- Keycap lever tool starter kit (076-00457)
- Precut VHB Strips (923-01801, 1x1; 923-01800, 1x.5)
- Keycap Lever (923-01803) **Note:** This tool is double sided. The smaller side is used for the arrow keys and Escape key.

## Electrostatic Discharge (ESD) Precautions

Proper ESD precautions must always be used when servicing this product. Make sure you are working on a properly grounded ESD-safe mat and are wearing a properly connected ESD-safe wrist strap.

For more information about ESD, refer to:

- [OP100: Electrostatic Discharge Precautions and Myths](#)
- [ATLAS](#) course for “ESD Precautions”

## Fixtures

- Protective battery cover (923-03021)



- iPhone Display Press (661-08916)



- Battery support frame and press plate (923-03007)



- Trackpad gap offset tool (923-02998)

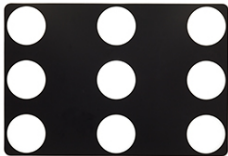


- Trackpad calibration weights, 200g and 800g (923-00462)

**Note:** Do not store weights above the repair bench. Use the foam packaging in which the weights are shipped for storage in tool drawers.



- Weight Placement Rubber Template (923-02462)



- Touch ID alignment tool kit (923-03032)





# MacBook Pro (16-inch, 2019), MacBook Pro (13-inch, 2020), MacBook Pro (13-inch, M1, 2020), MacBook Air (Retina, 13-inch, 2020), and MacBook Air (M1, 2020) Keycap Replacement

Keycap Replacement for the following models that use the scissor mechanism for the keycaps:

- MacBook Pro (16-inch, 2019)
- MacBook Pro (13-inch, 2020, Two Thunderbolt 3 Ports)
- MacBook Pro (13-inch, 2020, Four Thunderbolt 3 Ports)
- MacBook Pro (13-inch, M1, 2020)
- MacBook Air (Retina, 13-inch, 2020)
- MacBook Air (M1, 2020)



This is the quickest and most cost-effective procedure for fixing the following symptoms:

- Key stuck in up or down position
- Key press feels uneven or stiff
- Keycap not responding

The procedure involves three basic steps:

**Note:** This procedure may seem familiar, however there are some important differences. Always be sure that the lever tool is pointing in the proper direction. For direction, see the map below.

1. Applying the adhesive to the keycap lever tool.
2. Pressing and holding the keycap lever tool on the keycap for 10 seconds.
3. Pulling the keycap in the correct direction to release snaps.



For video instruction, refer to [SV421: Keycaps Replacement](#).

For part numbers, refer to the [Keycap Kit Part Numbers](#) section below.

For the correct scissor to use, refer to the [Scissor Map](#) section below.

For detailed information on the procedure, refer to the [Procedure for Removing and Replacing Keycaps](#) section below.

**Note:** If a keycap replacement does not resolve the issue, you must replace the entire top case. To confirm the correct keyboard country code and part number, refer to [How to identify keyboard localizations](#). Use the exploded view in the service guide to confirm the correct top case part number before ordering a service part.

## First Steps

- Before replacing the keycap on an unresponsive keyboard, be sure to clean the keyboard thoroughly with compressed air. Then remove the keycap, spray the well with compressed air, and check for liquid damage.
- Always install a new keycap. Do not attempt to reinstall the keycap that was removed.

## 1. Keycap Kit Part Numbers

**Important:** Keycap kits vary by computer color and keyboard language.

### Keycap Kits:

- Keycap kits are available for UK English (ISO), Arabic (ISO), U.S. English (ANSI), Chinese (ANSI), Korean (ANSI), and Japanese (JIS) version keyboards.
- The ISO Superkit is a European special character kit that, **when combined with the British (ISO) kit**, supplies keycap characters for the languages below. Click each language for ISO Superkit mapping.
  - [Croatian](#)
  - [Danish](#)
  - [Dutch](#)
  - [French](#)
  - [German](#)
  - [Hungarian](#)

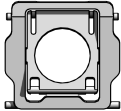
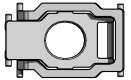
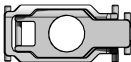
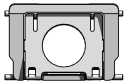
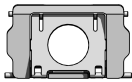
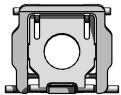
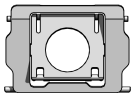
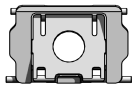
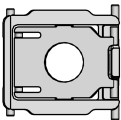
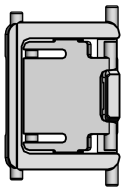
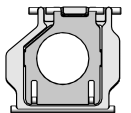
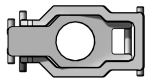
- [Icelandic](#)
- [International Z](#)
- [Italian](#)
- [Norwegian](#)
- [Portuguese](#)
- [Romanian](#)
- [Spanish](#)
- [Swiss French](#)
- [Swedish](#)
- [Turkey](#)
- [Turkish Q](#)
- Common Kits include the following keycaps:
  - ANSI: Space bar, Left Shift, Right shift, Caps Lock, Delete, Tab, Return, Escape
  - JIS: Space bar, Return, Left Shift, Right Shift, Delete, Escape, and Tab
  - ISO: Space bar, Right Shift, Caps Lock, Delete, Tab, Return, Escape

Keycap kits are shared across all models listed at the top of this article. *The MacBook Air (Retina, 13-inch, 2020) has an additional set of keycaps for the function row (923-03429).*

Part Number	Label Number	Language
923-03854	605-06246	US English (ANSI)
923-03855	605-06247	ANSI Common Keys
CH923-03854	CH605-06246	Chinese (ANSI)
KH923-03854	KH605-06246	Korean (ANSI)
B923-03854	B605-06246	British English (ISO)
ZM923-03854	ZM605-06246	ISO Superkit
ZM923-03855	ZM605-06247	ISO Common Keys
J923-03854	J605-06246	Japanese (JIS)
J923-03855	J605-06247	JIS Common Keys
AB923-03854	AB605-06246	Arabic (ISO)
FE923-03855	FE605-06247	Far East Common Keys
923-03429	605-00253	MacBook Air Function Row

## 2. Scissor Map

There are 11 different scissor types in the scissor kit (923-03863). The MacBook Air (Retina, 13-inch, 2020) has an additional function row scissor that ships with the function row keycaps (923-03429). Use the maps below to see which scissor to use if it is necessary to replace a scissor. A scissor only needs to be replaced if it is broken.

Symbol	Scissor
A1	
B1	
C1	
D1	
E1	
F1	
G1	
H1	
I1	
J1	
K1	
L1 MacBook Air (Retina, 13-inch, 2020) only	

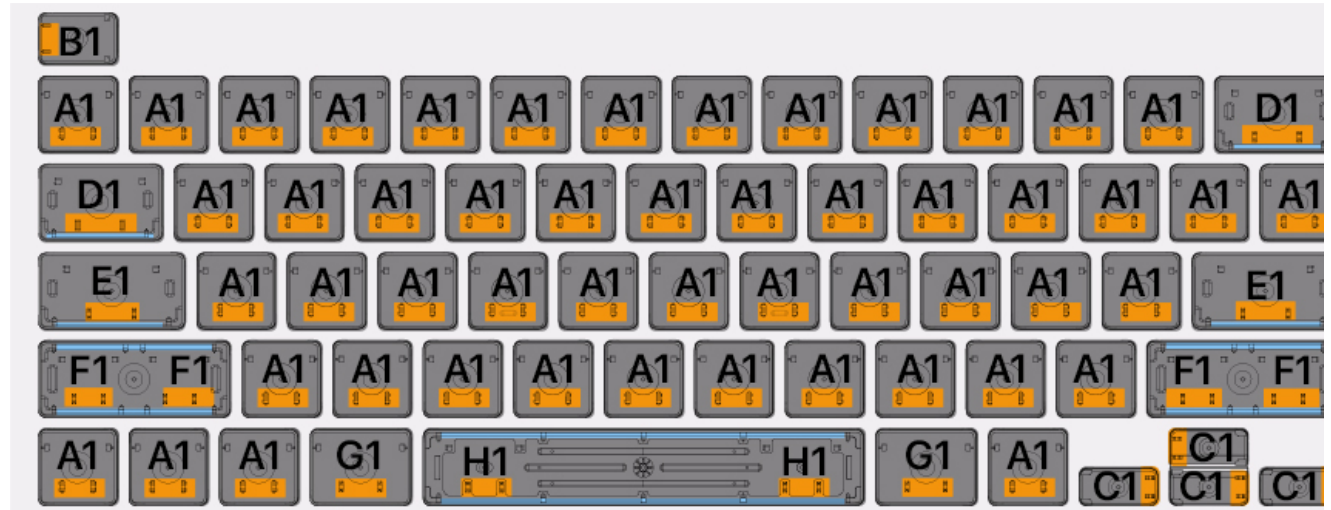
The symbols on the map below correspond to the symbol on the scissor bag. Orange indicates where the snaps

are located and the blue indicates link bars.

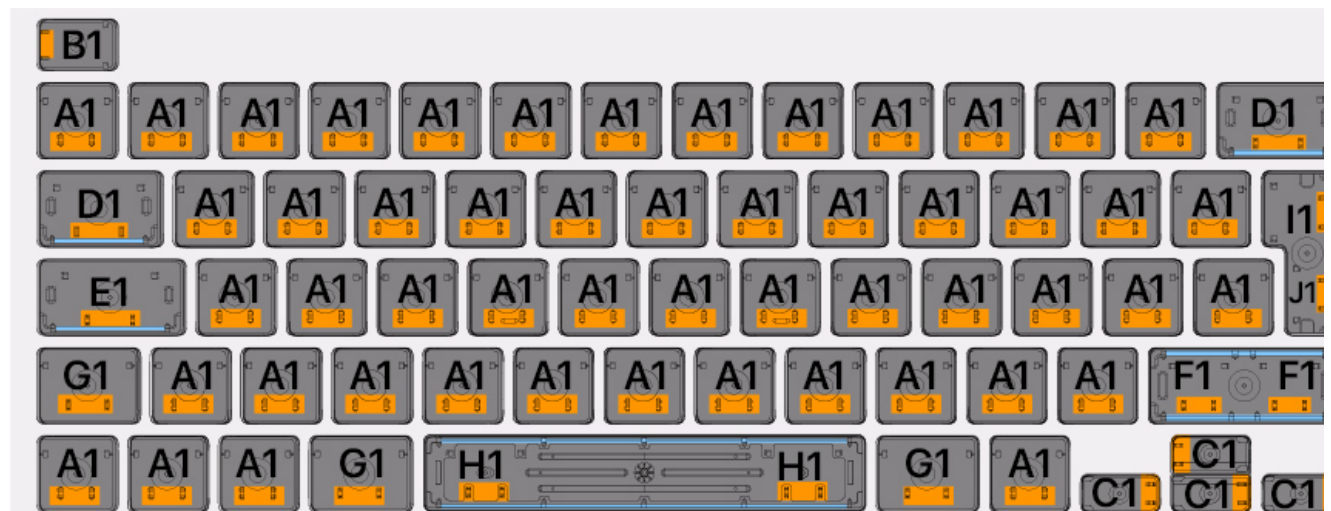
**Note:** MacBook Air (Retina, 13-inch, 2020) keyboard has an additional row of keys.



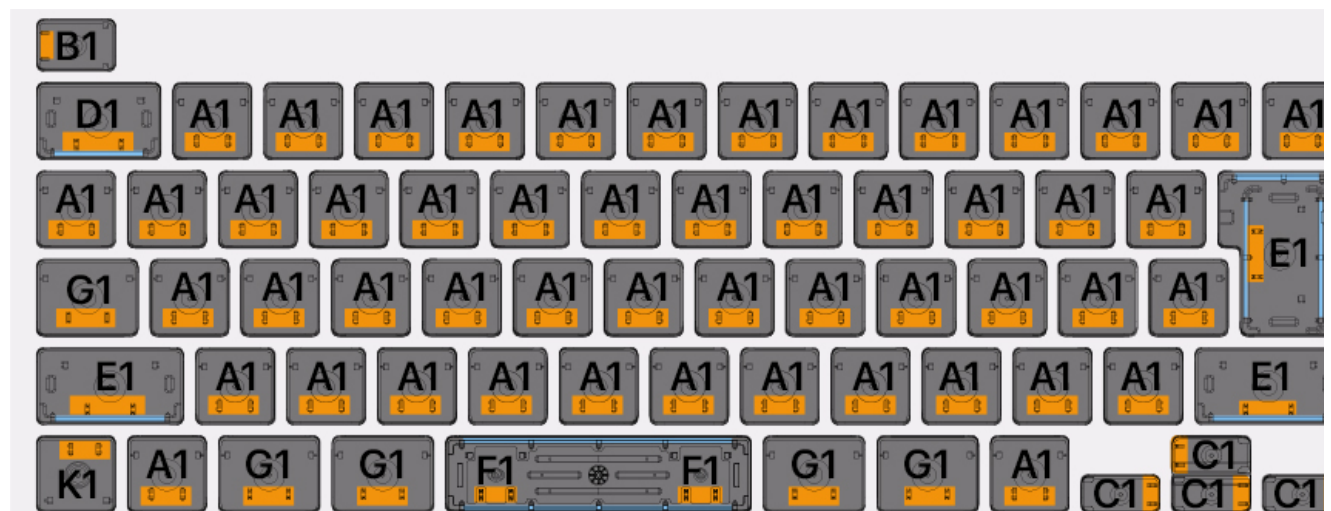
#### ANSI



#### ISO



#### JIS



### 3. Procedure for Removing and Replacing Keycaps



**Caution:**

- Shut down the computer before replacing a keycap.
- Press the keycap lever very gently on the keycap when initializing the VHB adhesive strip. The top case should not bend when pressing the keycap lever onto the keycap.
- Only the keycaps and scissors are replaceable. A damaged dome or metal hooks requires a top case replacement.
- Check the rubber dome and raised metal areas inside the keycap well.
  - When the rubber dome is pressed and released, it should spring back upright. If the rubber dome is off center or damaged, replace the top case.
  - If the metal hook that holds the slider bar of the scissor mechanism is bent, try to bend it back to a uniform 90-degree angle. If it is bent or broken beyond repair, replace the top case.
  - If the two metal ears are bent, use needlenose pliers to straighten them. If either or both ears are broken beyond repair, replace the top case.

**Tools:**

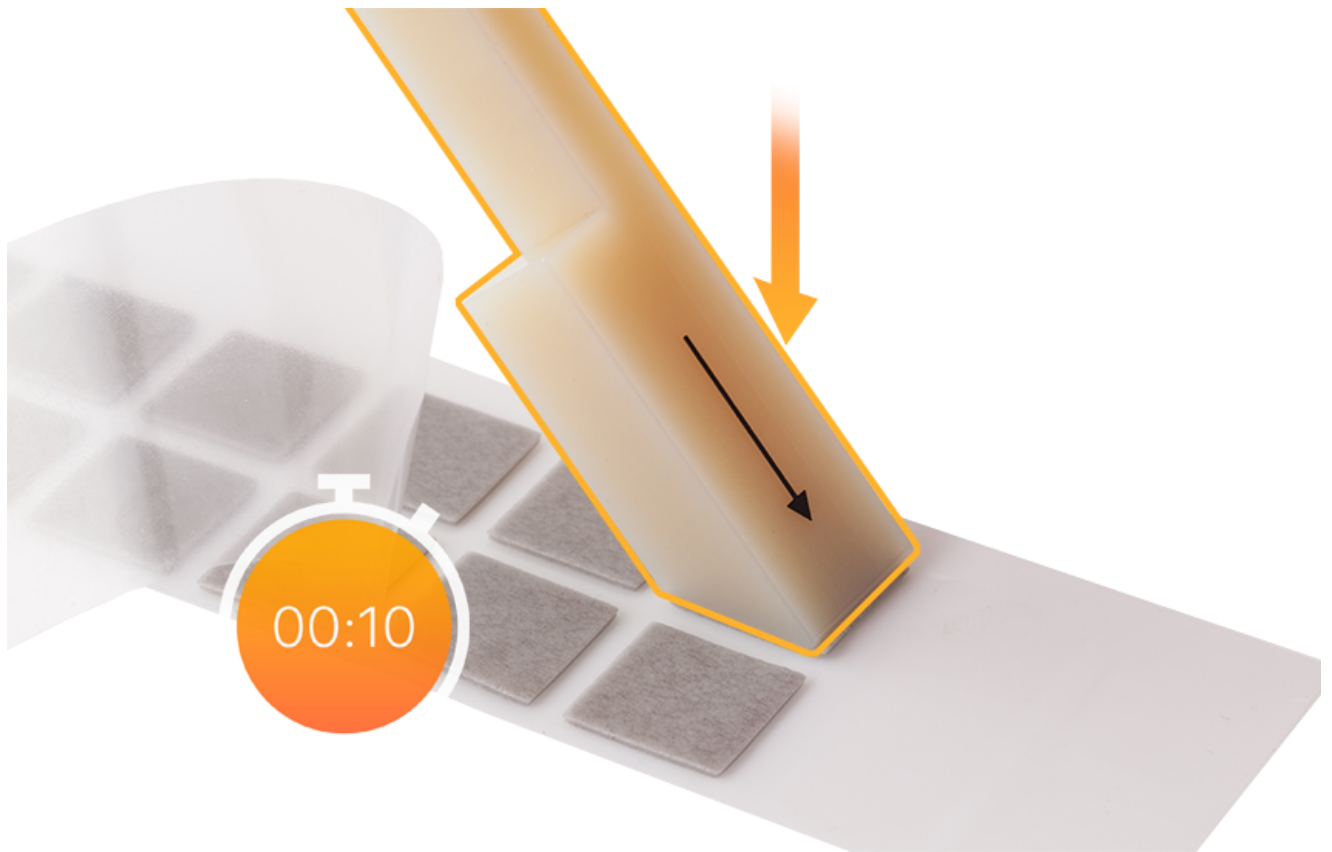
- Compressed air
- Precut VHB Strips (923-01801, 1x1; 923-01800, 1x.5)
- Keycap Lever (923-01803) **Note:** This tool is double sided. The smaller side is used for the arrow keys and Escape key.
- Keycap Lever Kit (076-00457) includes: Keycap lever and precut VHB strips
- Black stick
- ESD-safe tweezers

Follow these steps to remove and replace a keycap.

Each type of key on the keyboard requires a specific procedure.

**A. Removing and Replacing 1x1 keys****Removal**

1. Peel back the frosted liner from one side of the precut VHB strip. Press the large end of the keycap lever onto the 1x1 adhesive and hold for 10 seconds.



2. Lift the keycap lever, with the adhesive attached, from the clear liner.

3. Lightly press the keycap lever with the adhesive side down onto the key. **Important:** The arrow on the lever must always point to the hinged side of the keycap (toward the display) so the lever is always tilting away from the snaps and toward the hinge. Refer to the Scissor Map above for the location of the snaps. **Note:** The Caps Lock key on the JIS keyboard is different. Be sure to refer to the map.

4. Hold for 10 seconds to activate the adhesive.

**Note:** The adhesive is very strong. If the keycap lever is accidentally placed onto the wrong keycap, continue with the removal process and replace with a new keycap.





check that it moves easily and lies flat when released. For easier inspection, turn on the keyboard backlight to illuminate the scissor.



7. Use compressed air to clean the keycap well. **Note:** If compressed air does not dislodge visible debris, use a black stick to gently dislodge the debris.

8. Remove the keycap and the adhesive from the keycap lever and discard both. **Note:** The adhesive is one-time use only and must be replaced for every keycap removal.

### Reassembly

**Important:** Always replace the removed keycap with a new one. Do not reuse keycaps.

1. Insert the hinged side of the keycap into the well at a 15-degree angle and gently push to engage the hinges.



2. Gently push down on the top of the keycap to engage the snaps.



3. Tap the key repeatedly to verify that it springs back each time. Compare the response of the new keycap with the response of the keycaps around it.

4. If the keycap does not appear to be correctly installed, start again at removal step one with a new keycap.

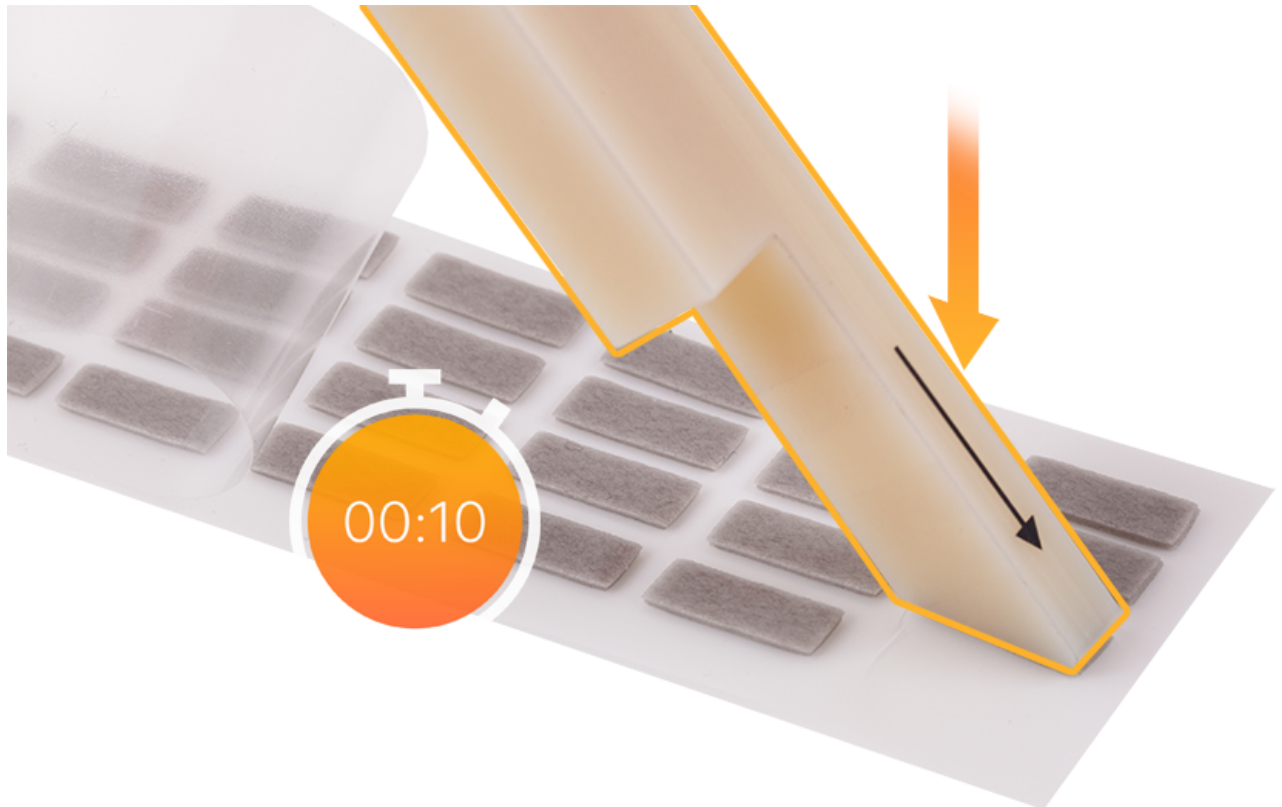
## B. Removing and Replacing Arrow Keys and the Escape Key

### Important:

- For the bottom row arrow keys, the hinges are on the left, so the arrow on the lever tool points toward the left.
- For the up arrow key and the escape key the hinges are on the right, so the lever tool arrow points toward the right.

### Removal

1. Peel back the frosted liner from one side of the precut VHB strip. Press the small end of the keycap lever onto the 1x.5 adhesive and hold for 10 seconds.



2. Lift the keycap lever, with the adhesive attached, from the clear liner.

3. Lightly press the keycap lever with the adhesive side down onto the key. **Important:** The arrow on the lever must always point to the hinged side of the keycap so the lever is always tilting away from the snaps and toward the hinge. Refer to the Scissor Map above for the location of the snaps.

4. Hold for 10 seconds to activate the adhesive.

**Note:** The adhesive is very strong. If the keycap lever is accidentally placed onto the wrong keycap, continue with the removal process and replace with a new keycap.

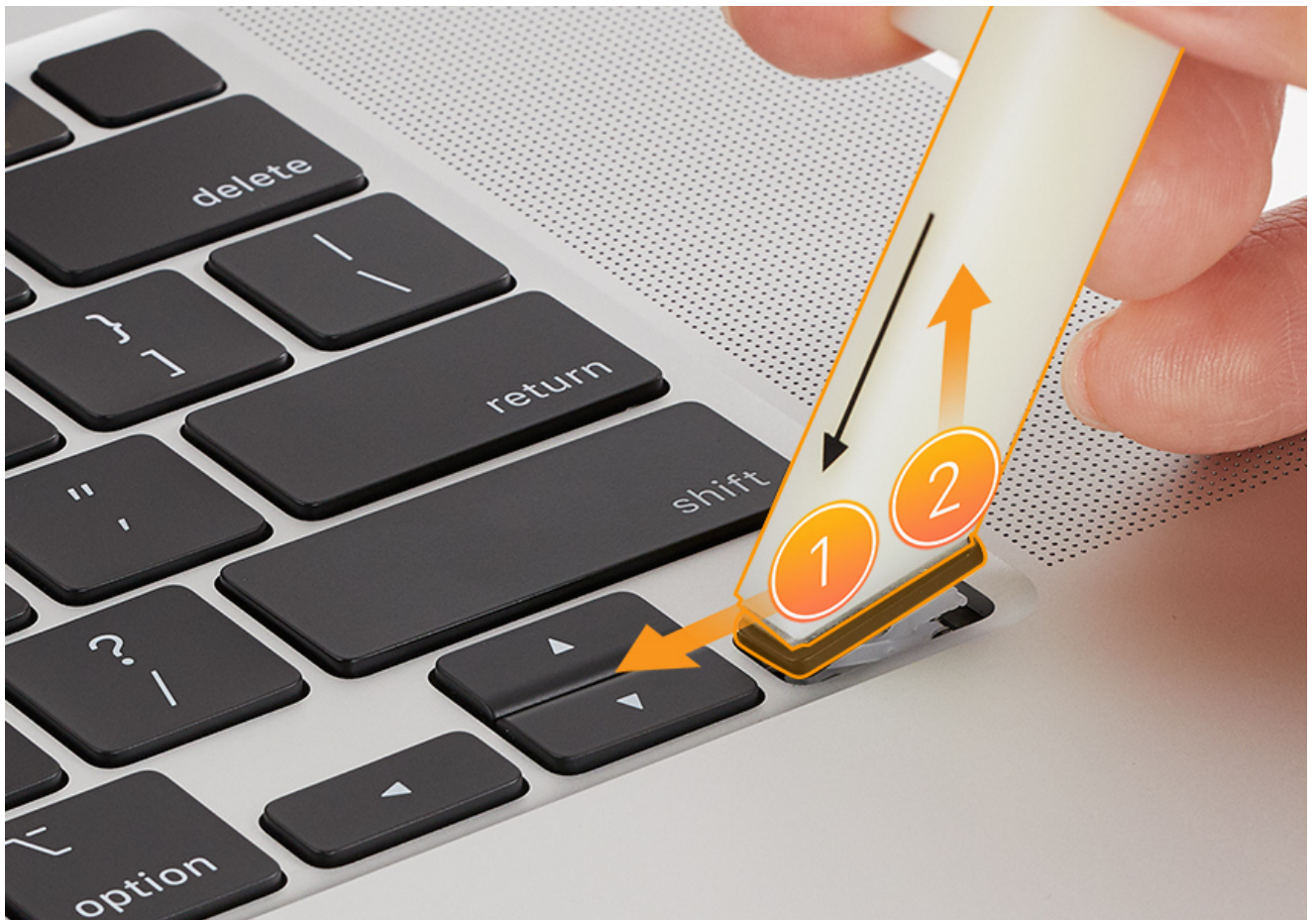




5. Push the lever tool towards the arrow and lift up just until you hear a snap. **Caution:** Be sure not to tilt the keycap more than 20 degrees. Doing so could cause the scissor mechanism to become damaged.



6. Push toward the left to release the keycap from the hinges (1). Lift up to remove the keycap (2).



7. Remove the keycap and the adhesive from the keycap lever and discard both. **Note:** The adhesive is one-time use only and needs to be replaced for every keycap removal.

### Reassembly

**Important:** Always replace the removed keycap with a new one. Do not reuse keycaps.

1. Use a black stick to lift the scissor slightly. Insert the hinged side of the keycap into the well at a 15-degree angle and then slide the key back toward the snap to engage the hinge. **Note:** This process is unique to the arrow keys and the Escape key.





2. Gently push down on the top of the keycap to engage the snaps.

3. Tap the key repeatedly to verify that it springs back each time. Compare the response of the new keycap with the response of the keycaps around it.

4. If the keycap does not appear to be correctly installed, start again at removal step one with a new keycap.

### **C. Removing and Replacing Link Bar Keys (Space Bar, Tab, Return, Shift, Delete, and Caps Lock)**

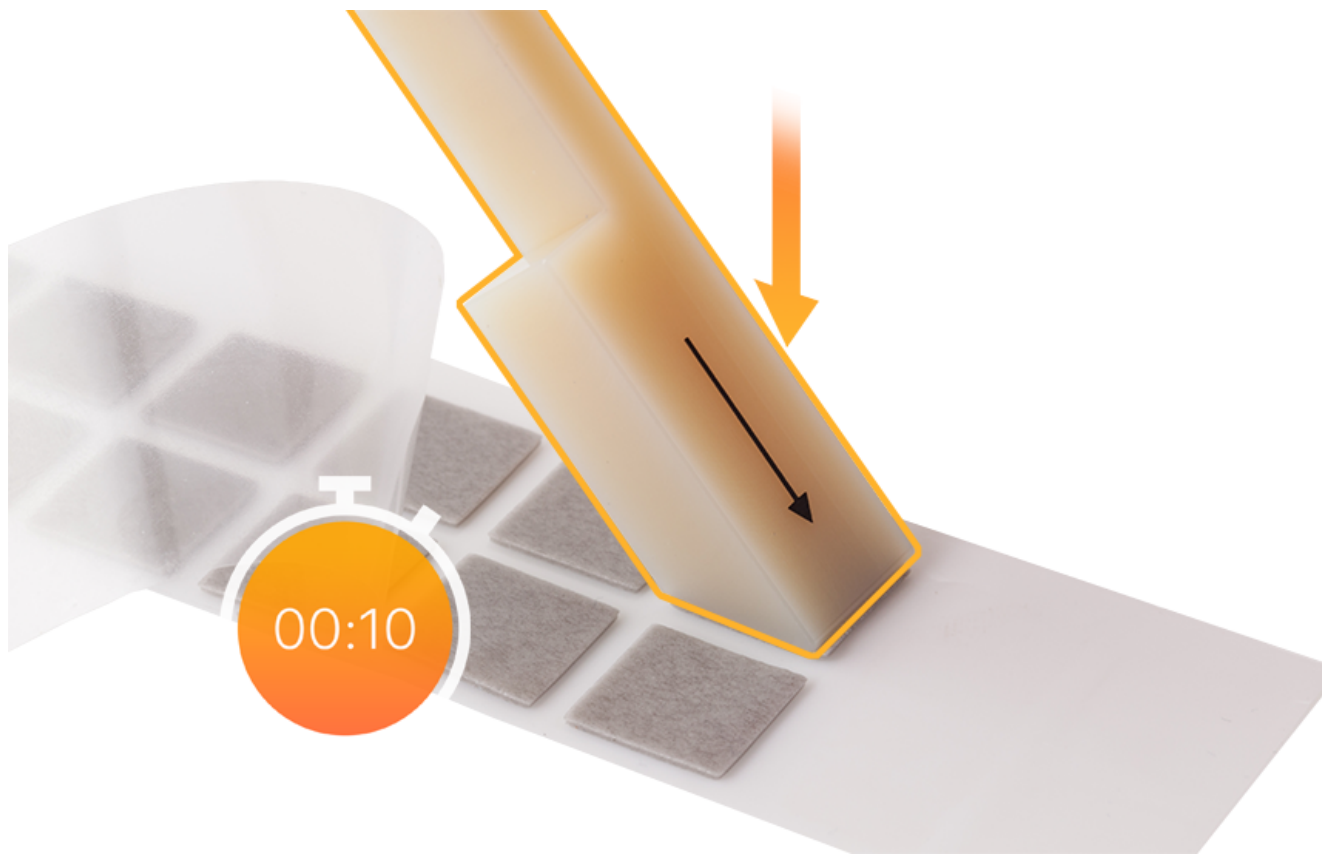
#### **Note:**

- For keys with two hinges and two snaps, use two keycap lever tools. Refer to the scissor map.
- Space bar, tab, return, shift, delete, and Caps Lock keys have link bars. The process for keys with link bars is the same. Refer to the scissor map for the link bar locations.

#### **Removal**

1. Align the lever tool over each set of scissors. Refer to the scissor map for correct placement.

2. Peel back the frosted liner from one side of the precut VHB strip. Press the large end of one the keycap lever onto the 1x1 adhesive and hold for 10 seconds. Repeat for the second lever.



3. Lift the keycap levers, with the adhesive attached, from the clear liner.

4. Lightly press the keycap lever with the adhesive side down onto the key. **Important:** The arrows on the levers must always point to the hinged side of the keycap so the levers are always tilting away from the snaps and toward the hinge. Refer to the Scissor Map above for the location of the snaps.

5. Hold for 10 seconds to activate the adhesive. **Note:** The adhesive is very strong. If the keycap lever is accidentally placed onto the wrong keycap, continue with the removal process and replace with a new keycap.



6. Simultaneously lift both levers in the direction of the arrow until you hear the snaps release. Then lift the keycap off of the keyboard. **Note:** The bottom link bar on larger keys might stick to the keycap during removal. If so, use a black stick to unsnap it so it stays in the keycap well.



7. Once the keycap has been removed, use a black stick to carefully and gently lift each scissor up and down to check that they move easily and lie flat when released. For easier inspection, turn on the keyboard backlight to illuminate the scissors.



8. Use compressed air to clean the well. **Note:** If compressed air does not dislodge visible debris, use a clean cloth to gently dislodge the debris.

9. Remove the keycap and the adhesive from the keycap lever and discard both. Note: The adhesive is one-time use only and must be replaced for every keycap removal.

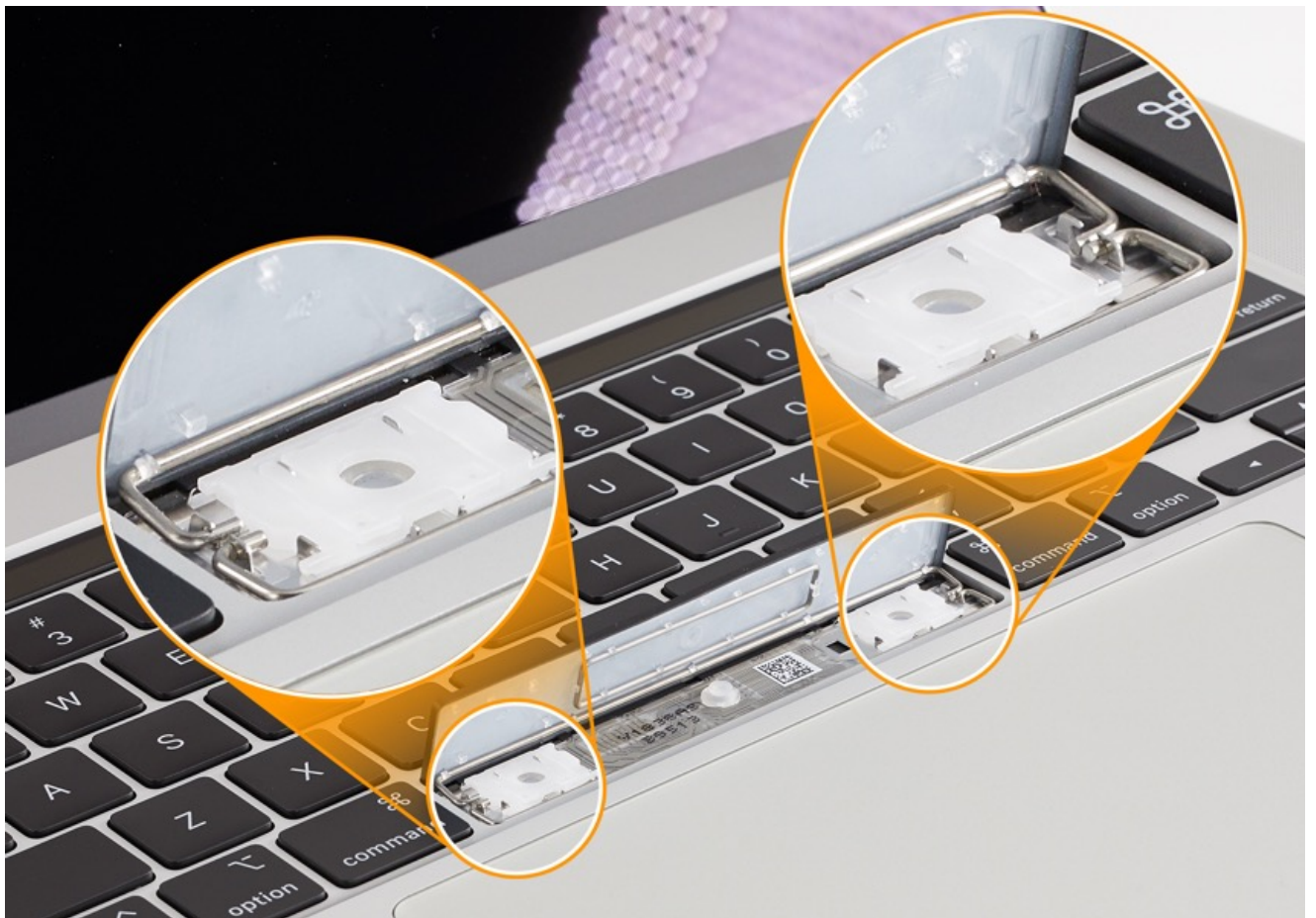
### Reassembly

**Important:** Always replace the keycap with a new one. Do not reuse keycaps.

1. Check that the hinge bar is preinstalled on the replacement keycap. The snap bar remains in the top case.



2. Position the keycap at a 15-degree angle and insert the top link bar into the metal hooks located on each side of the well.



3. Push the key forward to set the bar in place. Then gently push down on the four snaps to engage the keycap.



4. If the keycap does not appear to be correctly installed, start again at removal step one with a new keycap.

#### D. Replacing Scissors

**Important:**



- Only remove the scissor if the scissor is damaged. Be sure to replace it with the correct type of scissor. Refer to the scissor map to find the correct scissor.
- Be sure to take note of the correct orientation of the scissor. This will be important for reassembly.

1. Use a black stick to disengage the scissor pins from the metal hooks.



2. Once the pins are disengaged, use tweezers to lift the scissor out of the well.



## Reassembly

### Important:

- Before installing a new scissor, check the scissor map to ensure you are installing the correct one.
- Be sure the scissor is installed in the correct orientation.

1. Use compressed air to clean the keycap well. **Note:** If compressed air does not dislodge visible debris, use a black stick to gently dislodge the debris.

2. Use tweezers to align the scissor in the well and engage the upper hooks.



3. Engage the scissor pins with the lower hooks with your finger or a black stick. When engaged the pins should look like number 1. Number 2 shows the pin not engaged.



4. Once the scissor has been installed, use a black stick to carefully and gently lift the scissor up and down to check that it moves easily and lies flat when released. For easier inspection, turn on the keyboard backlight to illuminate the scissor.



# Take-Apart Procedure Notes

## Reassembly Steps

When the take-apart procedure doesn't include a final list of parts that you need to reinstall to complete reassembly, reinstall parts in the reverse order in which they're listed in the beginning of the Removal section.

## Images

Some service guide articles include images of preproduction devices. There may be small differences between the image shown and the device you're servicing, but the procedures are the same unless noted.

## Screw Sizes

All screw sizes are about the total length of the screw.



# MacBook Air (M1, 2020) Bottom Case

## First Steps



### Warning:

- To avoid damaging parts, attach the battery cover and disengage battery power immediately after removing the bottom case.
- Do not apply external power while the computer is under repair.

### Important:

- Only Apple-certified technicians should perform this procedure. For more information, refer to [OP1859: About Apple service certifications](#).
- Wear an ESD wrist strap and take precautions to avoid ESD.

Before you begin:

- Shut down computer.
- Unplug all cables.
- Put on ESD strap.
- Place computer face down on a clean, flat surface.



## Tools

1. Pentalobe screwdriver
2. Black stick



## Steps For Removal



**Caution:** The configuration of the bottom case is dependent on the thermal module. Always use the serial number to identify the correct version of the bottom case.

1. Remove 10 Pentalobe security screws:

Part Number	Color	Location	Screw
923-05164	Space Gray	1	
923-05166	Space Gray	2	
923-05165	Space Gray	3	
923-05167	Silver	1	
923-05169	Silver	2	
923-05168	Silver	3	
923-05170	Gold	1	
923-05172	Gold	2	
923-05171	Gold	3	



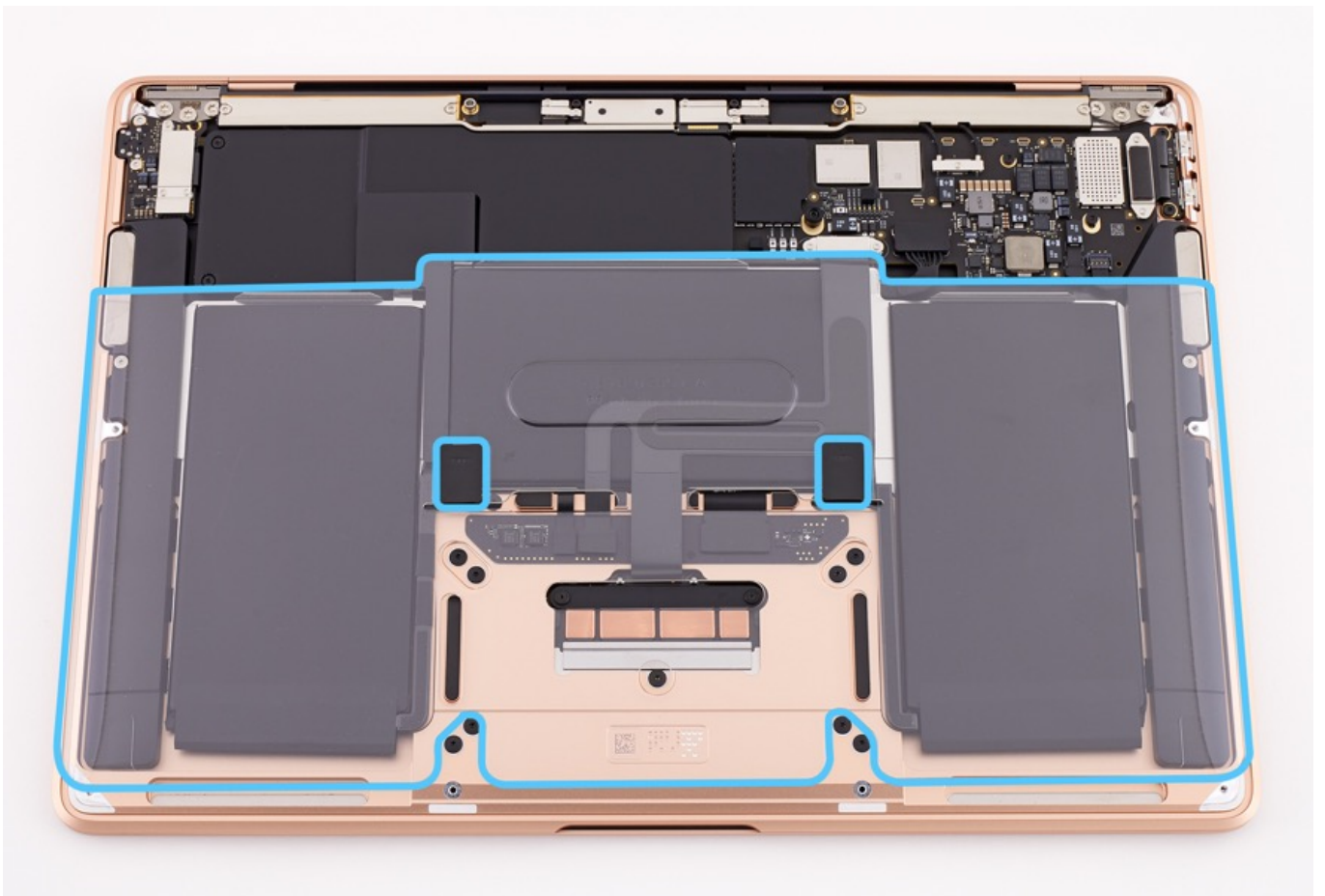


2. Lift from the top and remove bottom case.

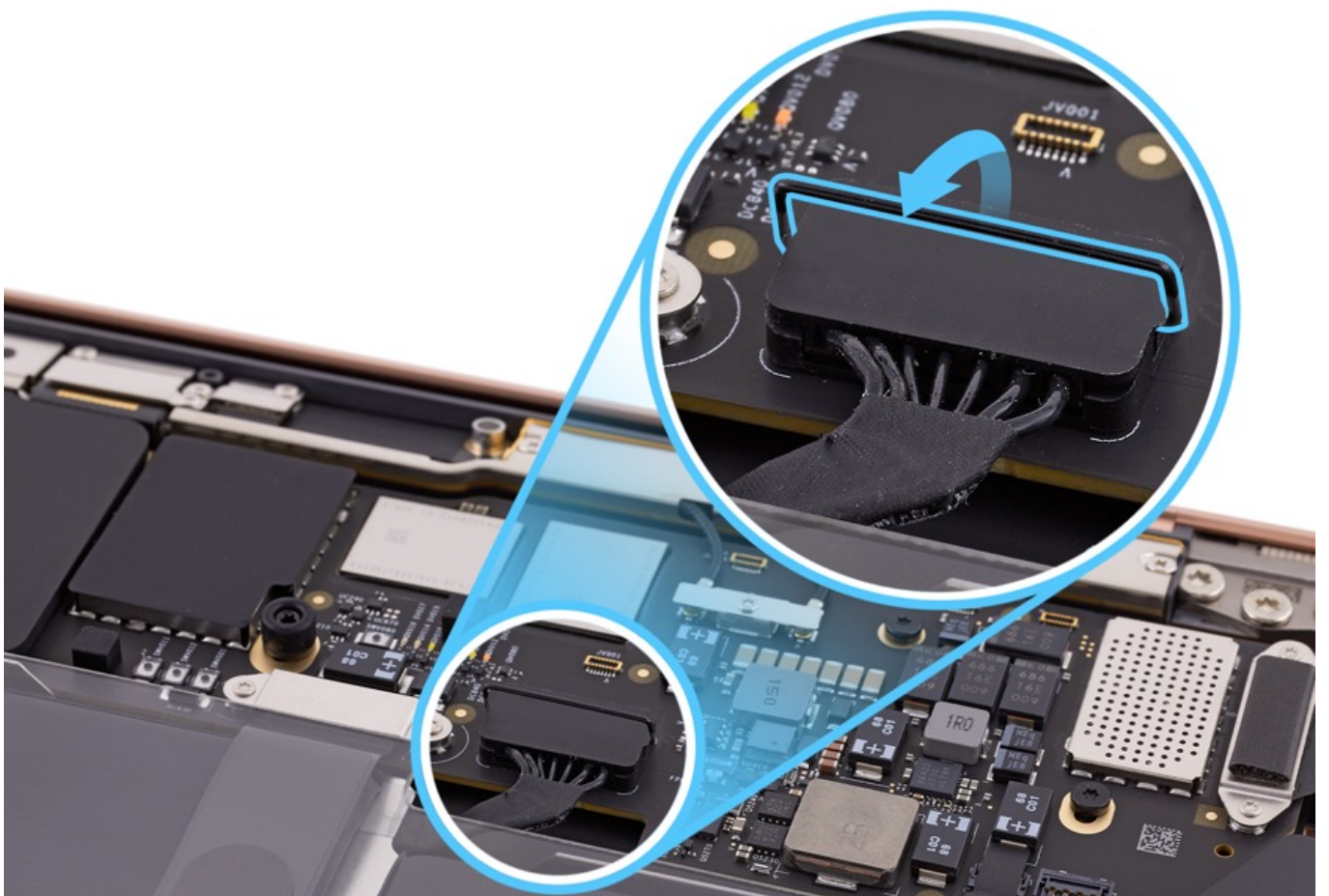


**Warning:** Immediately after removing bottom case, always attach battery cover (923-03021) and disconnect the battery cable from logic board.

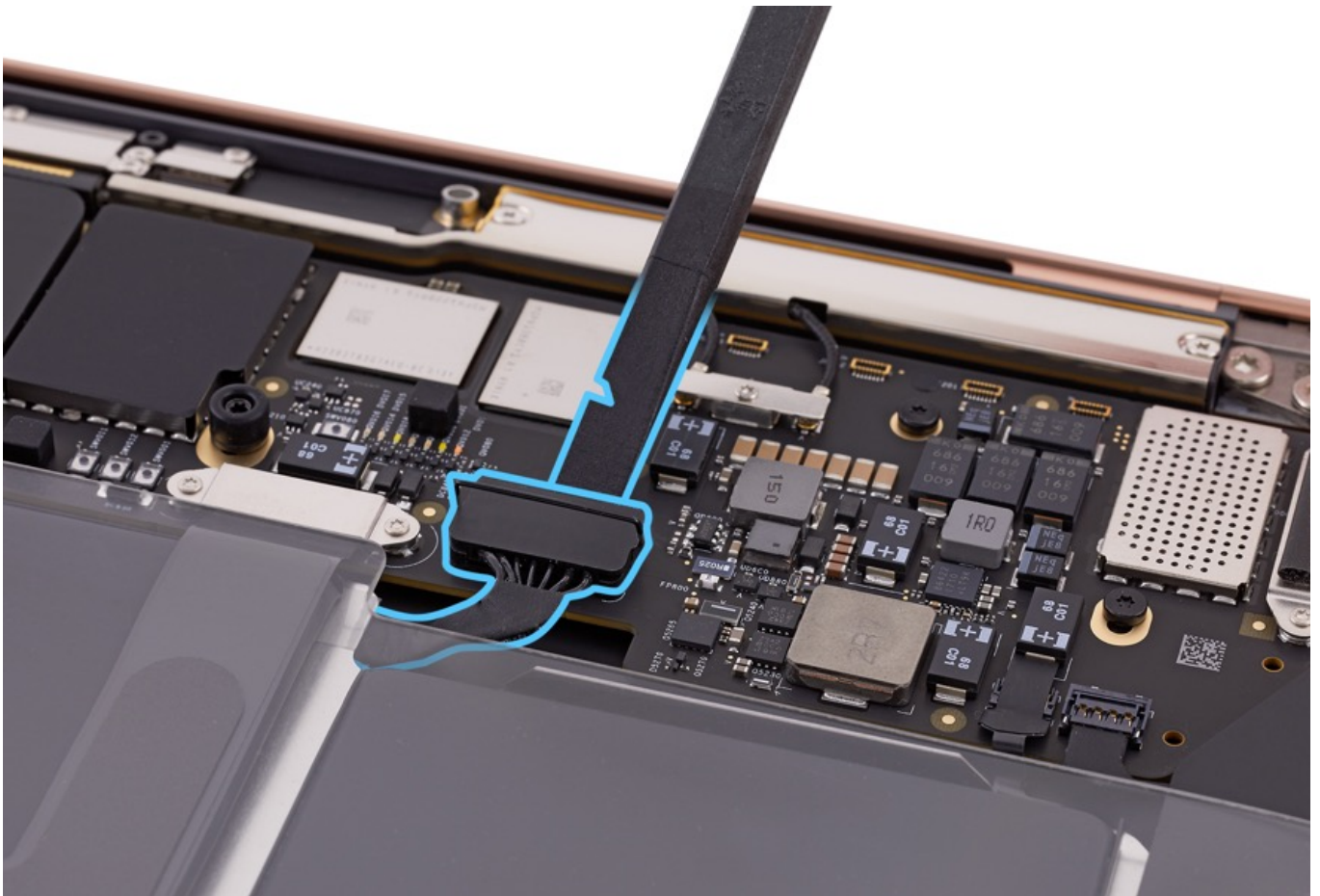
3. Align and attach the battery cover. Make sure the metal clips are secure.



4. Lift the lock bar on the battery connector. **Caution:** Do not use the lock bar as a handle to lift the connector.



5. With a black stick disconnect the battery connector from the logic board.



## Steps For Reassembly

**Note:** If you are installing a replacement bottom case, use a fine-tipped permanent marker to write the original system [serial number](#) (TP1689) inside the bottom case.

1. Make sure the bottom case interior is clean and free of debris.
2. Reconnect the battery connector to the logic board.



### Caution:

- When reconnecting the battery, make sure the lock bar is above the connector, not below it. If the bar is trapped underneath the connector when you apply pressure, it could damage either the bar or the connector pins on the logic board, leading to a logic board replacement.
- Lock down the lock bar all the way after inserting the cable.

3. Remove the battery cover from battery.
4. Reinstall the bottom case. Press lightly to ensure the bottom case snaps into place.
5. Confirm all the screw holes are aligned before installing the screws.
6. Install the screws in the order shown.



7. **Important:** Run the appropriate [AST 2 diagnostic suites](#) (TP1909).



# MacBook Air (M1, 2020) Input/Output (I/O) Board

## First Steps



### Warning:

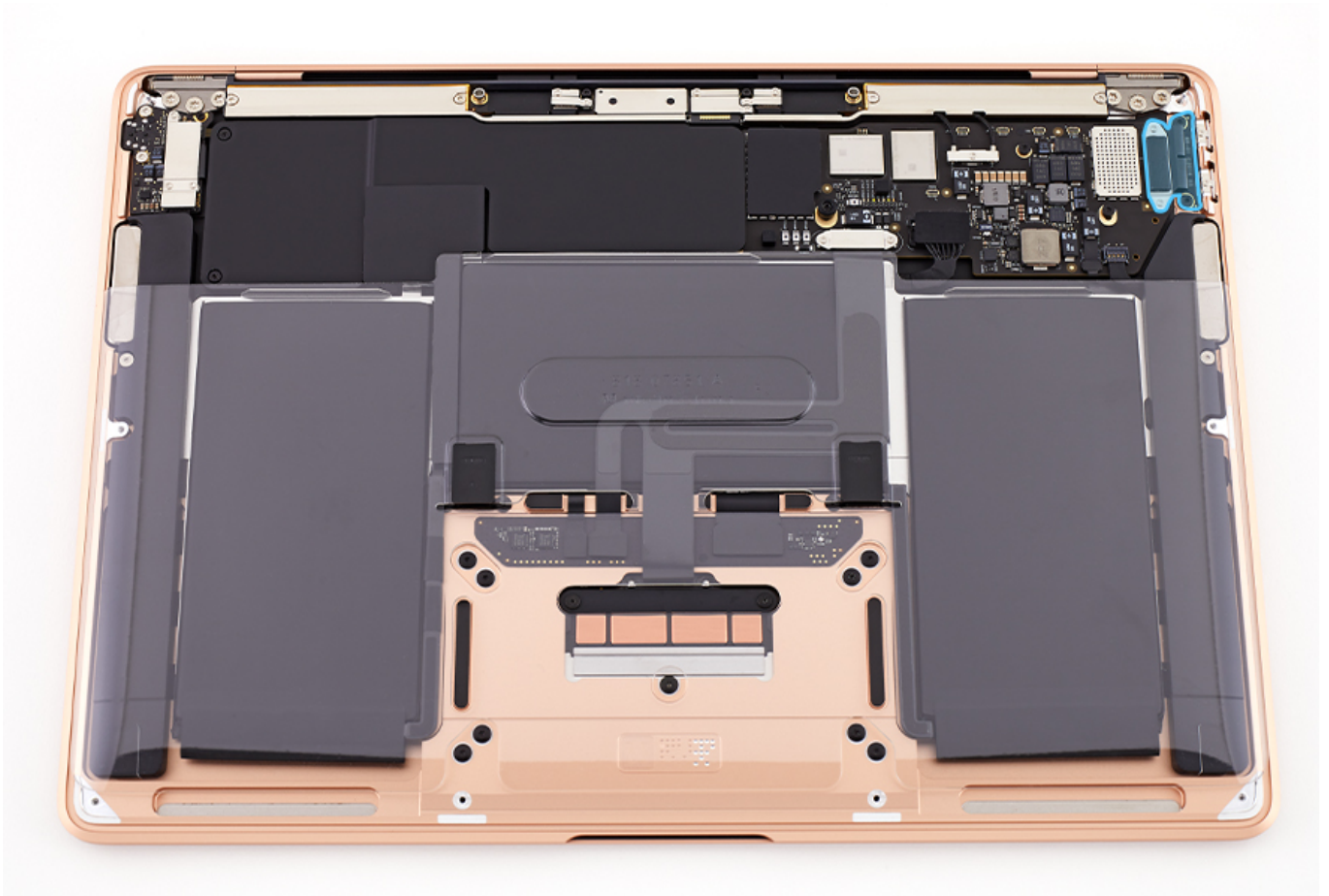
- To avoid damaging parts, attach the battery cover and disengage battery power immediately after removing the bottom case.
- Do not apply external power while the computer is under repair.

### Important:

- Only Apple-certified technicians should perform this procedure. For more information, refer to [OP1859: About Apple service certifications](#).
- Wear an ESD wrist strap and take precautions to avoid ESD.

### Remove:

- [Bottom Case](#)



## Tools

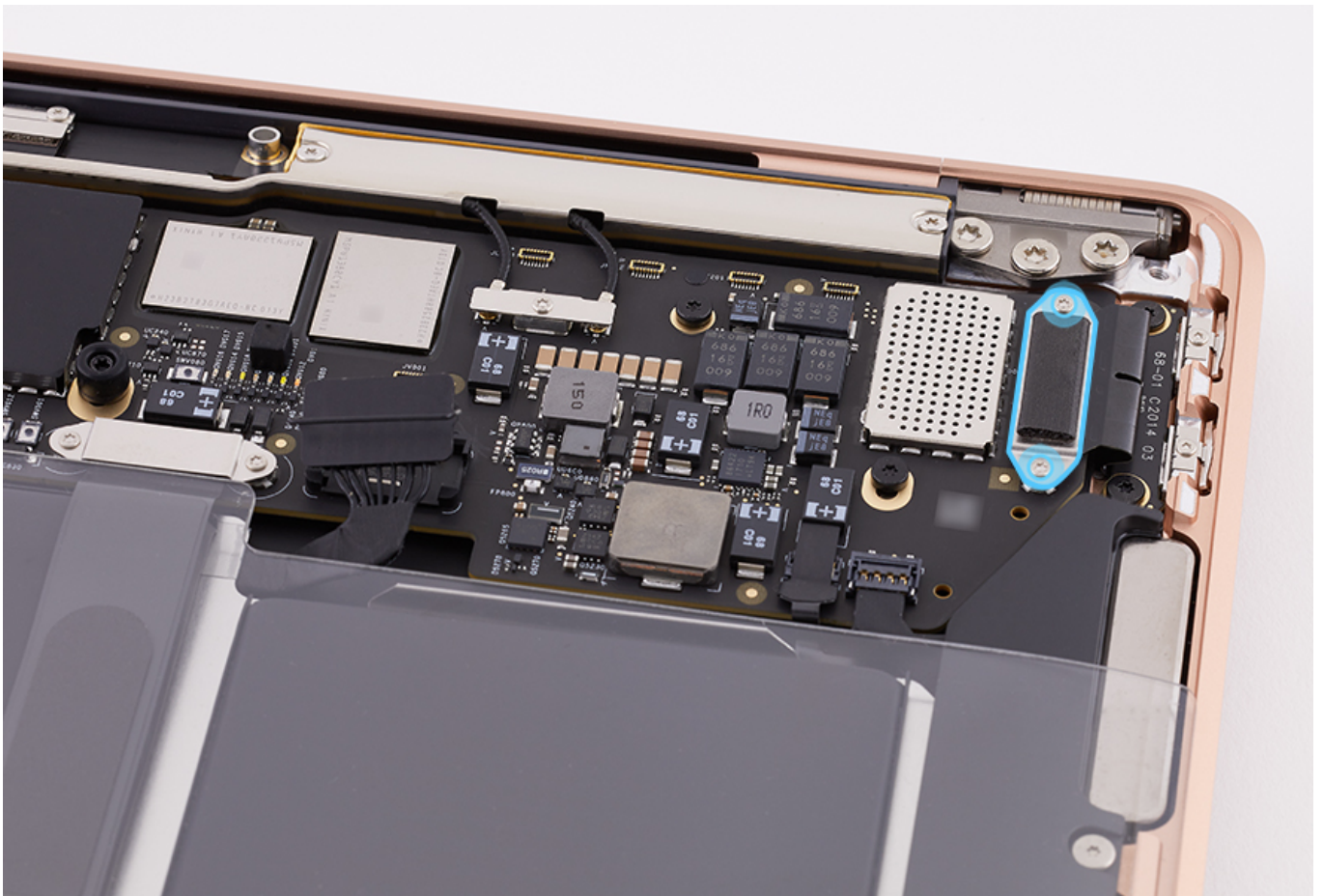
1. Torx T3 screwdriver (magnetized)
2. Torx T5 screwdriver (magnetized)
3. Black stick



## Steps For Removal

1. Remove two T3 screws from the I/O board cowling. Remove the cowling and save for reuse.

- T3: 923-04003

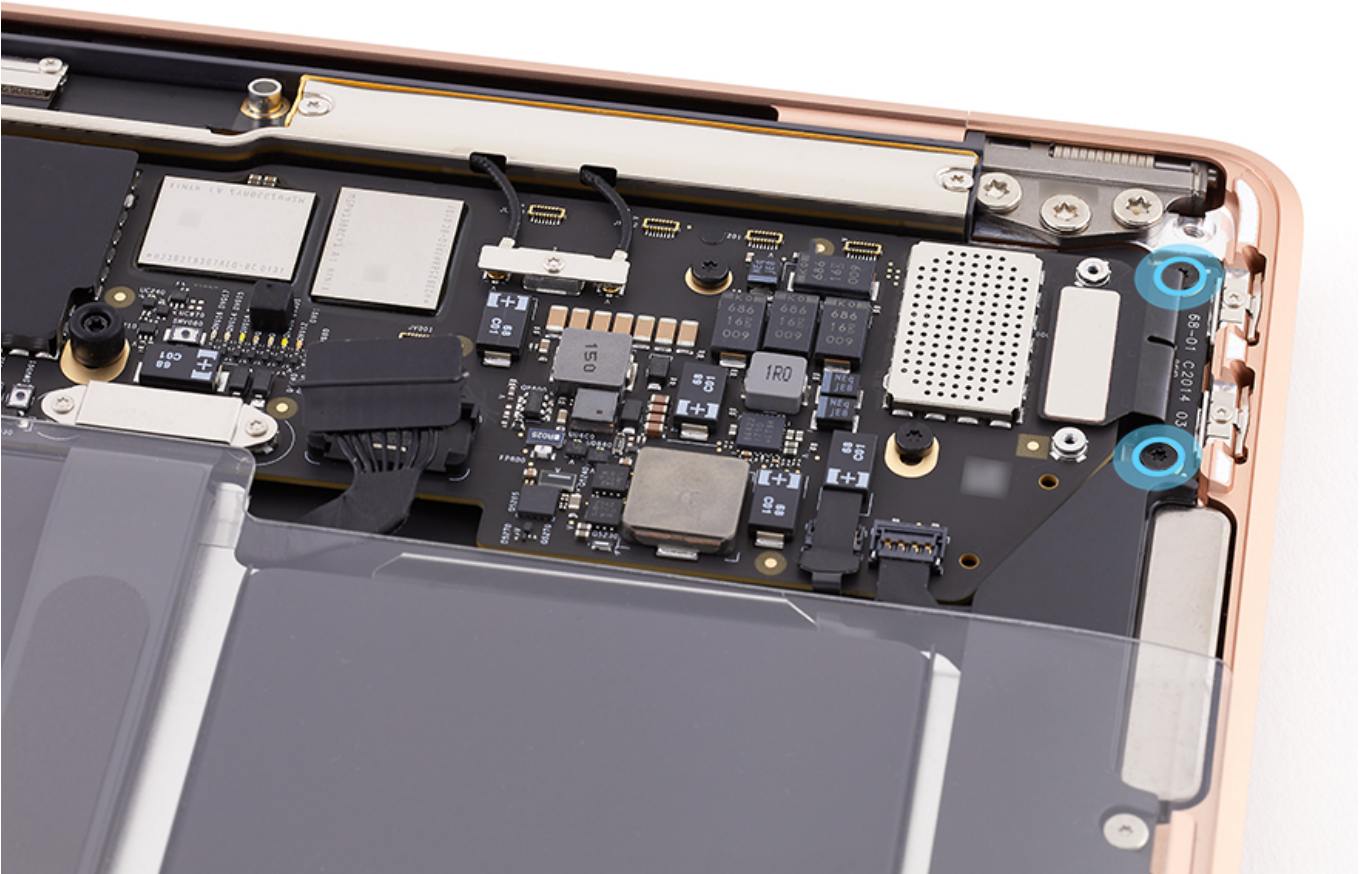


2. Remove two T5 screws for the I/O board.

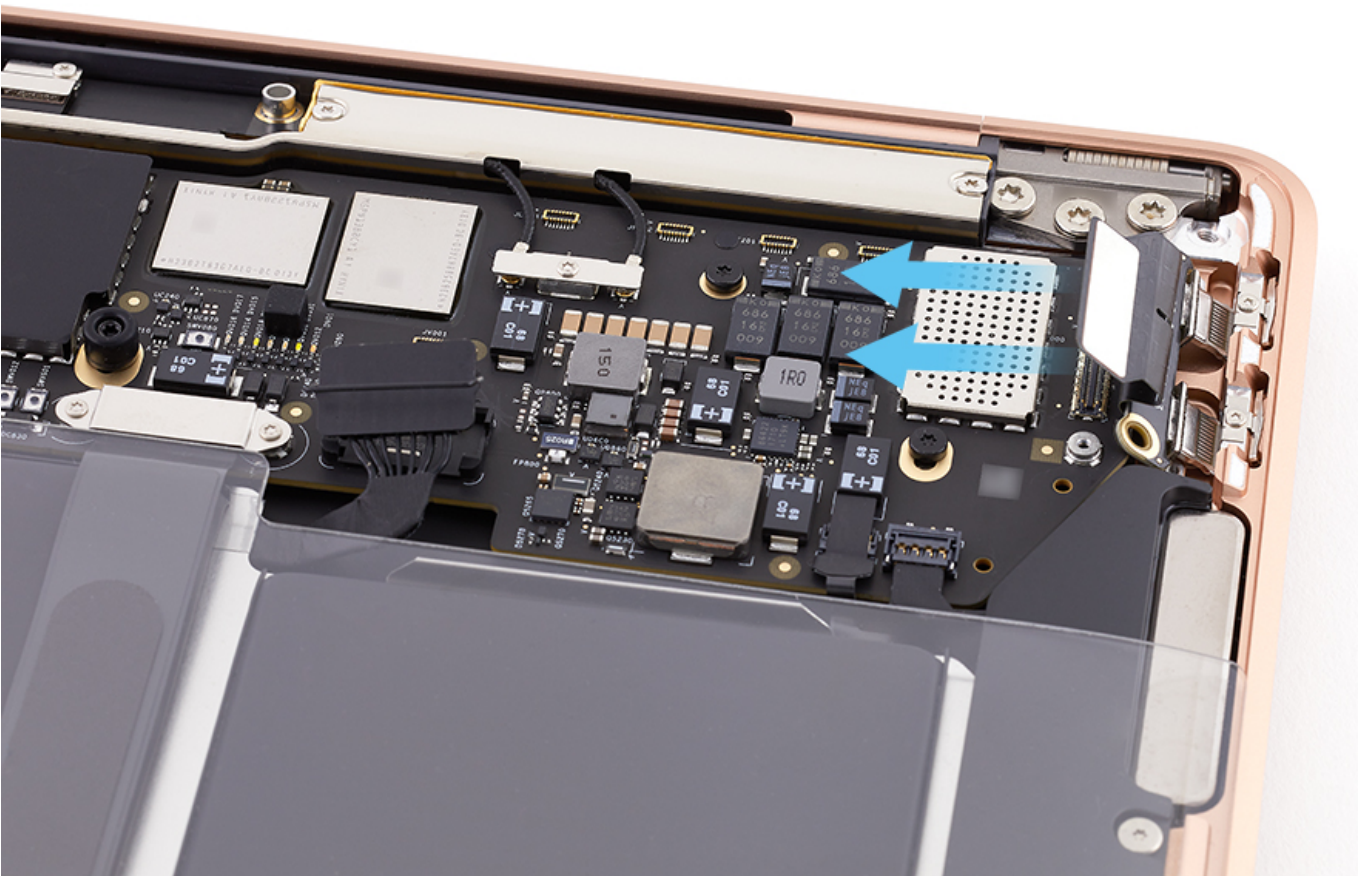
- T5: 923-03975







3. Grasp the board by the sides and gently slide it out of the ports.

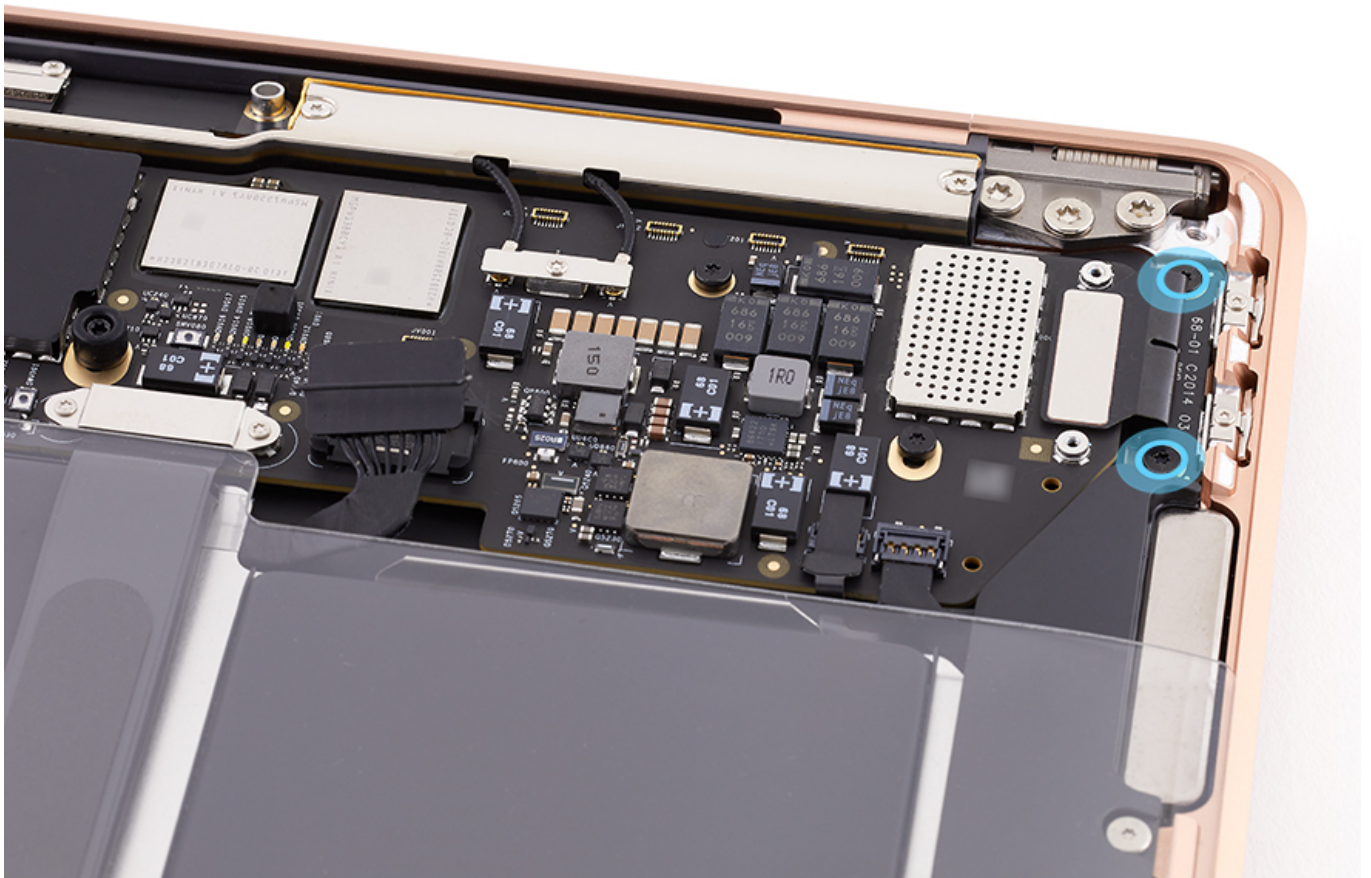


### Steps For Reassembly

1. Place the I/O board into position in the top case.

2. Loosely reinstall the two T5 screws.

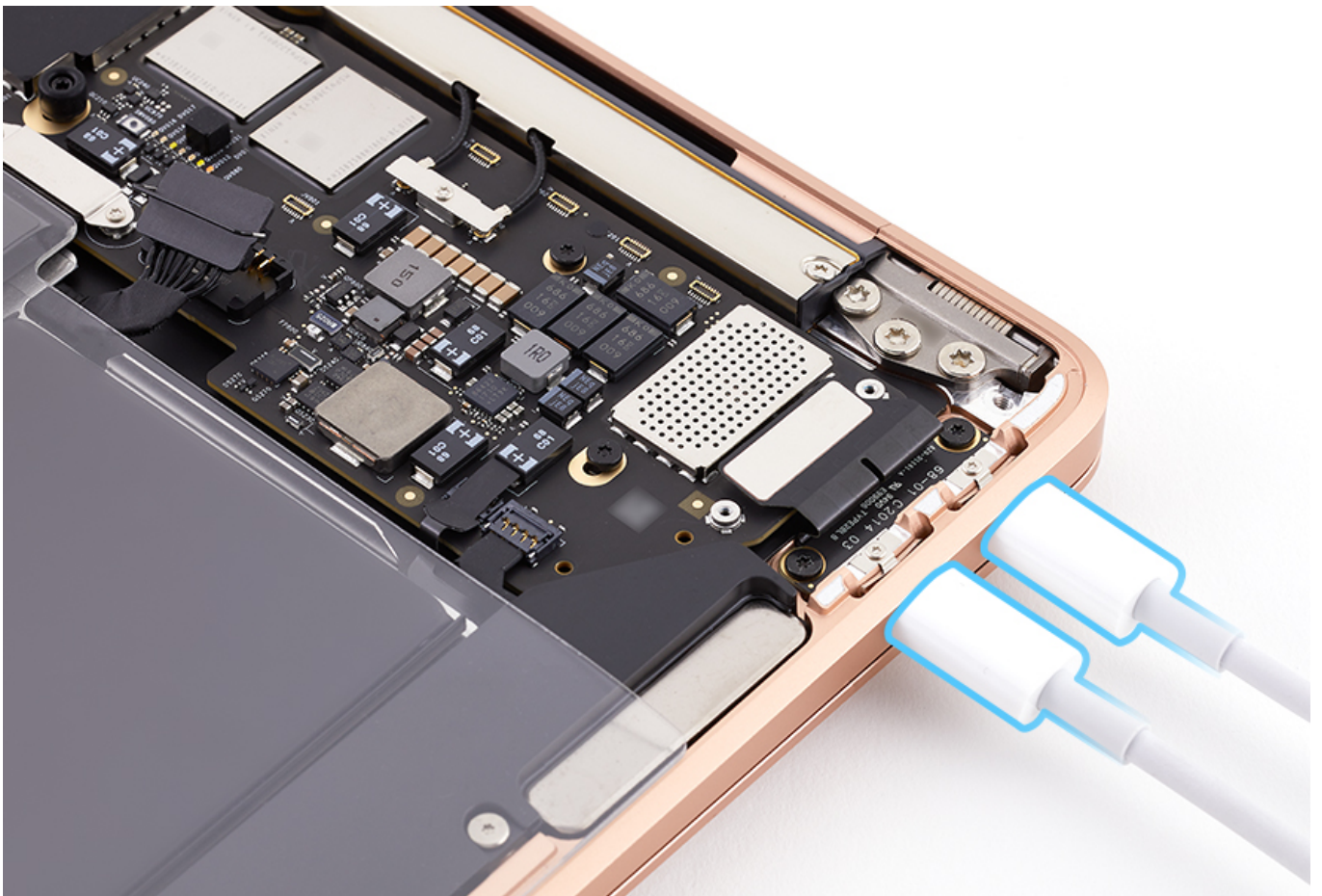
- T5: 923-03975



3. Plug an external USB-C charging cable into both ports to check the alignment.

**Important:** The charging cable should **not** be plugged into power.





4. Keep the the charging cable in the ports and torque the screws all the way down.
5. Remove the charging cable.
6. Reinstall the cowl and the two T3 screws.
7. Reinstall the [bottom case](#).
8. **Important:** Run the appropriate [AST 2 diagnostic suites](#) (TP1909).

# MacBook Air (M1, 2020) Trackpad

## First Steps



### Warning:

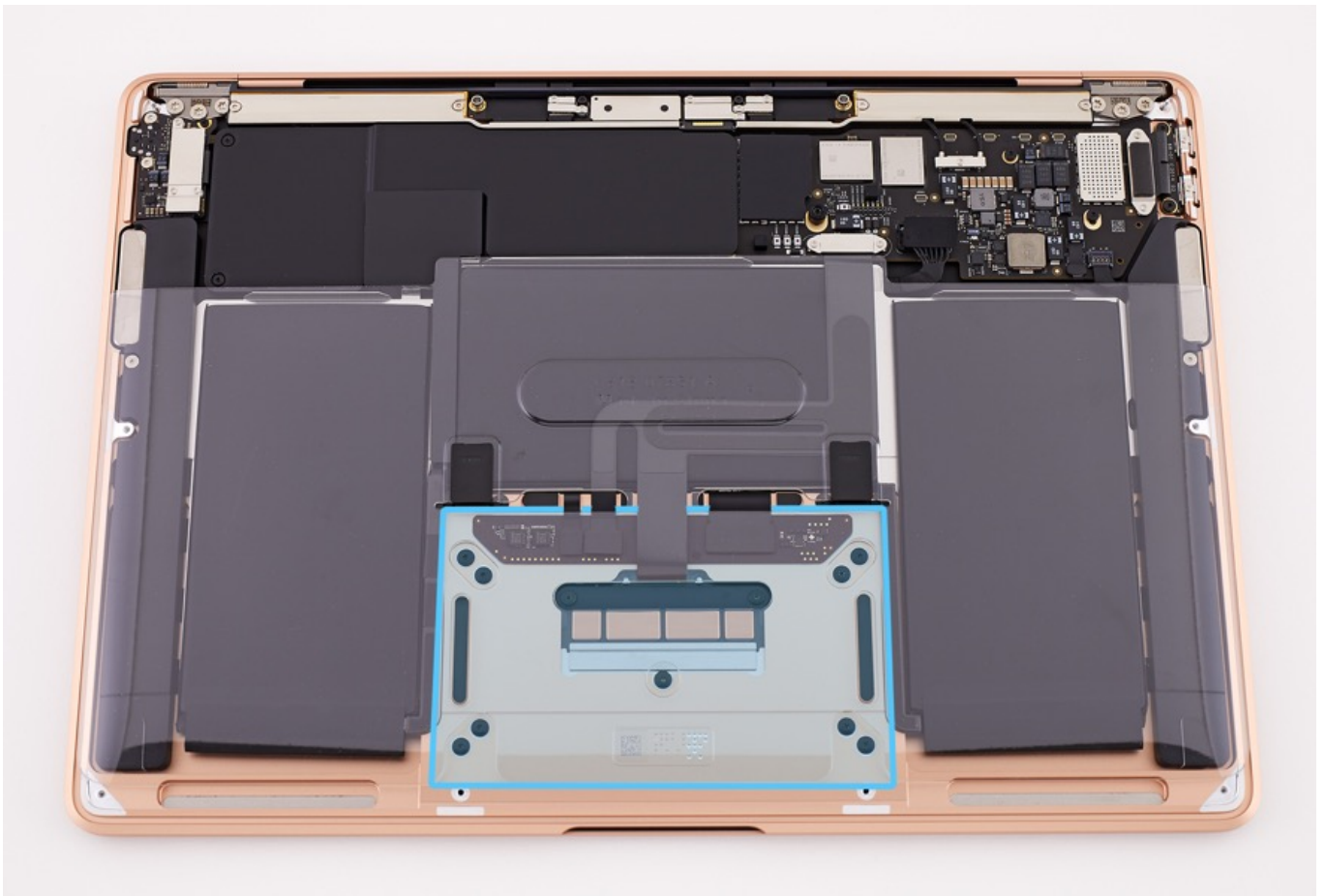
- To avoid damaging parts, attach the battery cover and disengage battery power immediately after removing the bottom case.
- Do not apply external power while the computer is under repair.

### Important:

- Only Apple-certified technicians should perform this procedure. Wear an ESD wrist strap and take precautions to avoid ESD.
- 

### Remove:

- [Bottom Case](#)



## Tools

1. 0.3–1.2 Nm torque driver (set to 0.35 Nm) (923-0735)
2. 10–34 Ncm torque driver (set to 16 Ncm) (923-02995)
3. ESD-safe, flat-nosed tweezers
4. Torx T5 screwdriver
5. Black stick
6. T5 bit (923-02996)
7. Gap offset tools (923-02998)
8. Post-It Notes
9. Kapton tape



## Steps For Removal

1. Open the computer and place the top case on the table with the display over the table edge.

2. Remove one T5 middle screw (1) and eight T5 outer screws.

- T5: 923-03002 (1)

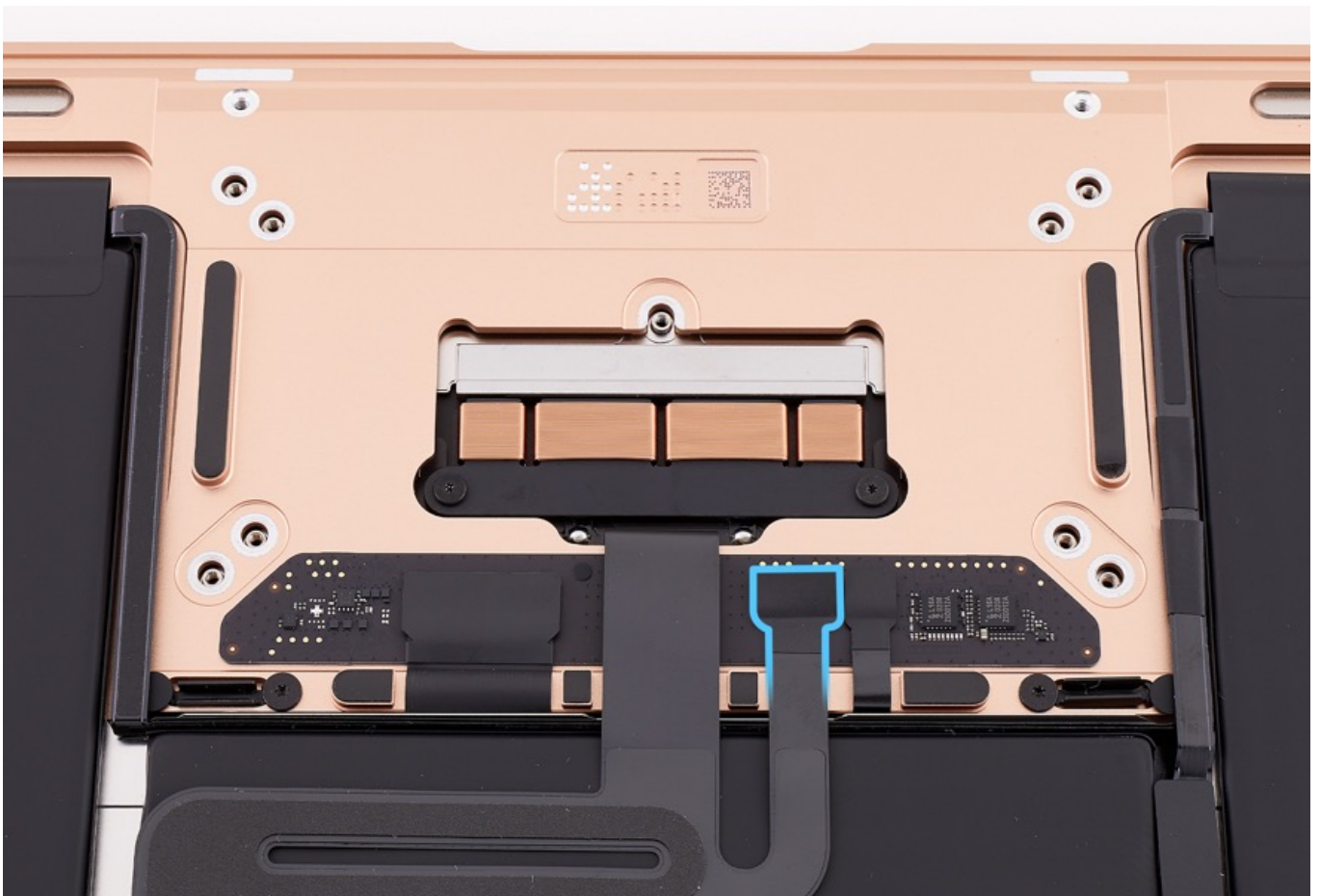


- T5: 923-02880



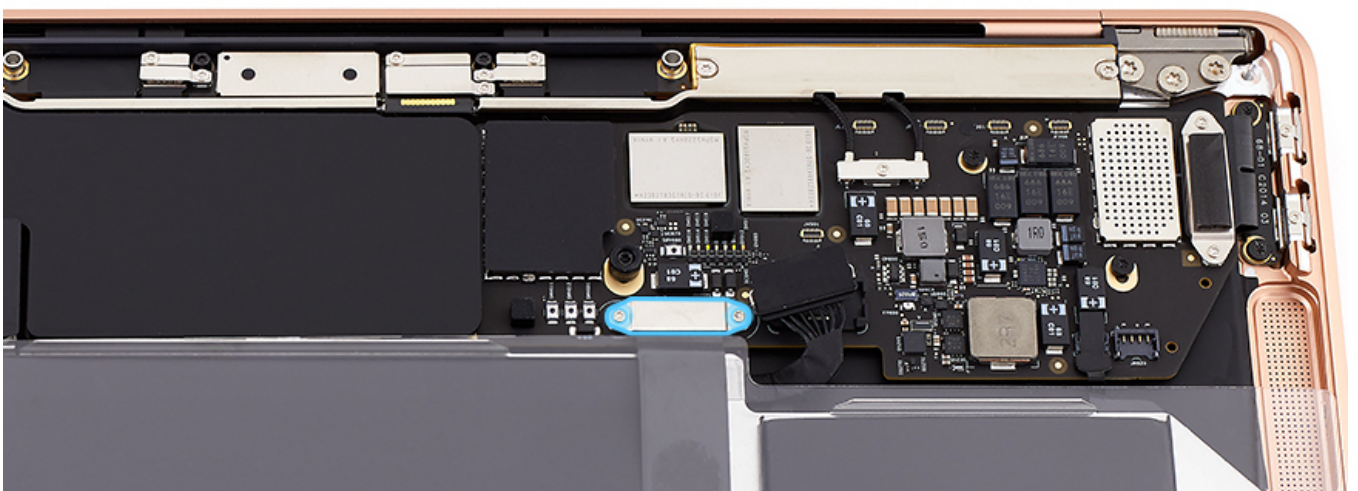
3. Remove the battery cover to disconnect the IPD flex cable from the daughter board.





4. Remove the two T3 screws from the IPD flex connector cowling and disconnect the IPD flex connector from the logic board.

- T3: 923-04003



5. Lift the computer assembly off the table while threading the trackpad cable through the top case opening.



6. Set the computer assembly aside. Turn the trackpad over so the shims fall on the table. Do not reuse the shims.

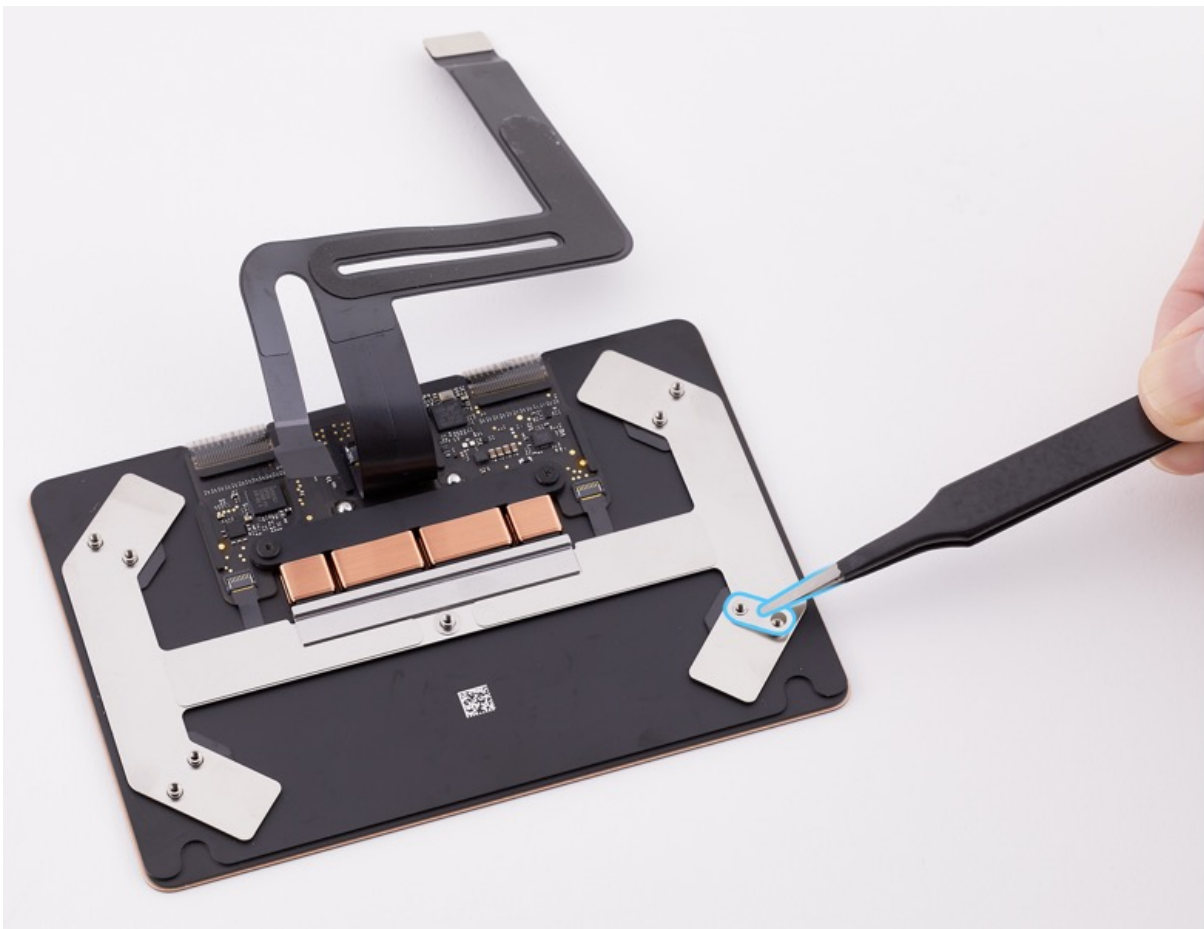
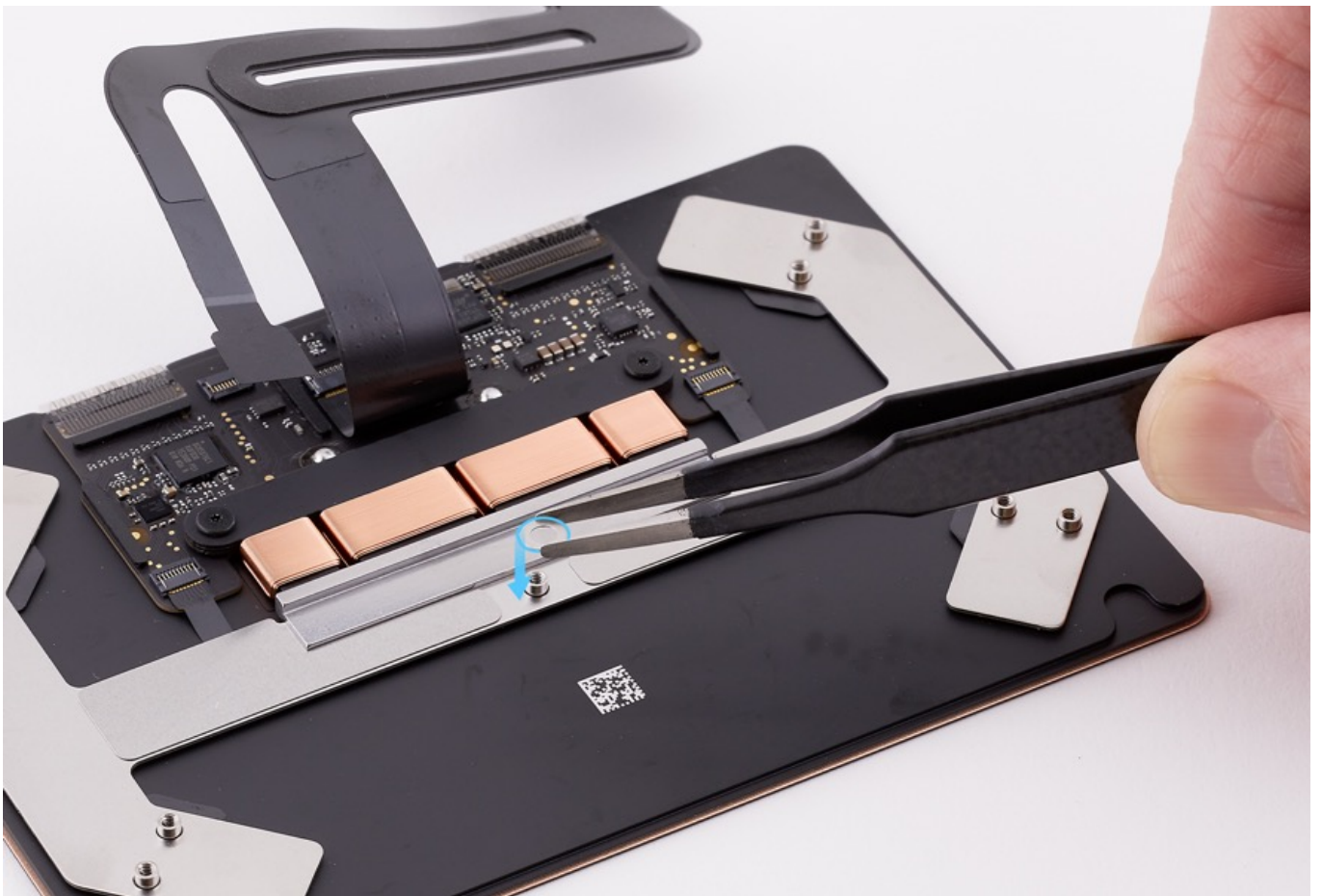
### Steps For Reassembly

**Note:** If reinstalling the trackpad, do not remove the IPD flex cable from the trackpad unless it is damaged. If installing a new trackpad, replace the [IPD flex cable](#) (RP1690) with a new one that is included with the replacement part.

1. Using ESD-safe, flat-nosed tweezers, install new shims to the outer screw bosses and the middle screw boss on the replacement trackpad.

**Note:** The replacement trackpad comes with three sizes of shims (0.075 mm, 0.125 mm, and 0.175 mm). Start with the 0.125 mm shim.

Part Number	Size
806-06495	0.075 mm
806-06497	0.125 mm
806-06499	0.175 mm
806-05805	0.075 mm round
806-05807	0.125 mm round
806-05809	0.175 mm round



2. Lower the top case over the trackpad while threading the IPD flex cable through the opening. Align the nine screw holes with the nine screw bosses.





3. Put on the battery cover and install the four outer corner screws about halfway to allow for trackpad alignment.

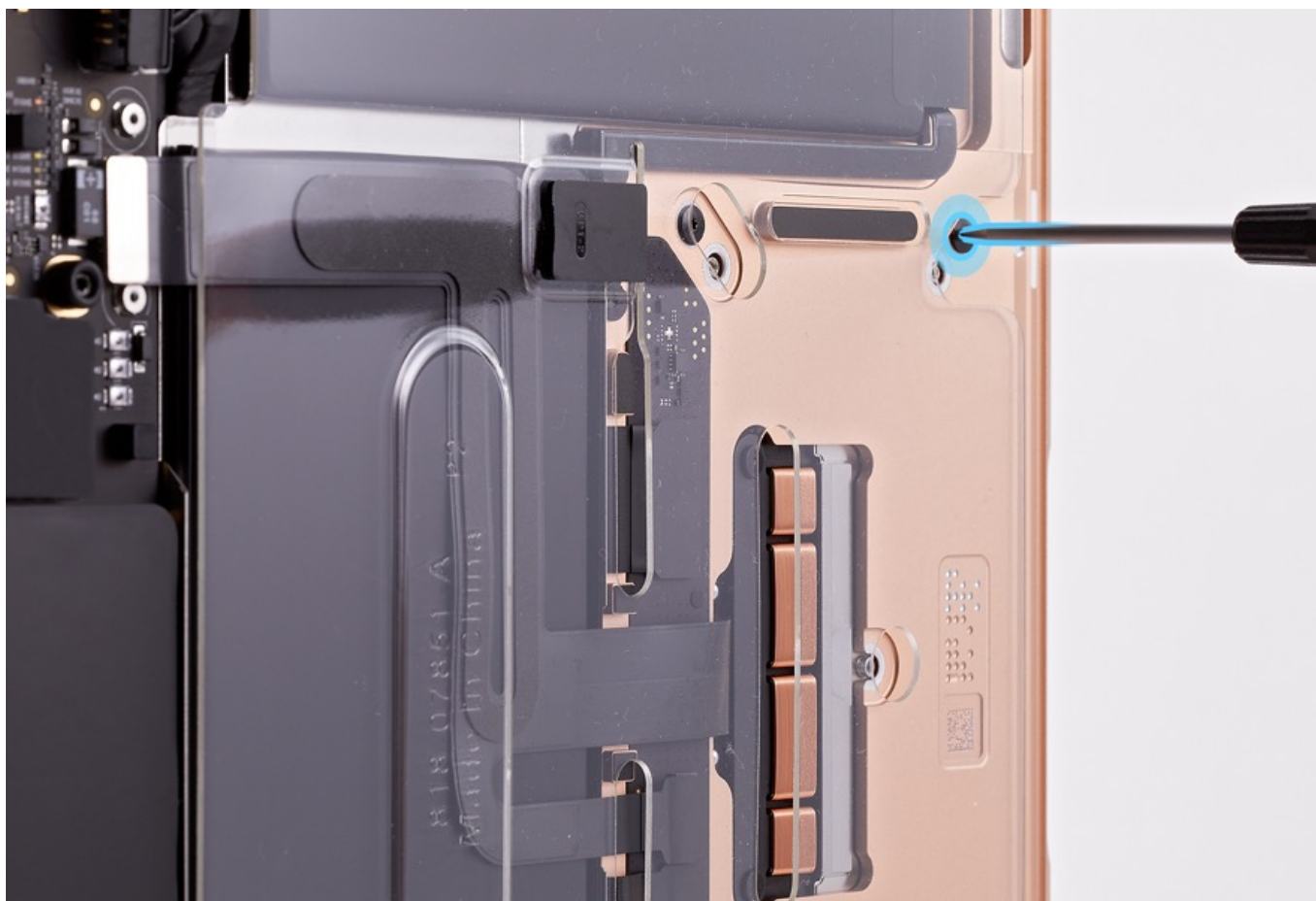
- T5: 923-02880



4. Turn the computer over and insert four gap offset tools in the corners of the trackpad. Place a piece of Kapton tape on each gap tool to keep the tool in place.



5. Place the open computer on its side. Use a T5 screwdriver to tighten the four outer screws.



6. To test the trackpad is at the correct height, align a single Post-It note on the upper edge of the trackpad. Run a finger



over the top case and trackpad to verify the trackpad is flush with the Post-It note.



7. Align a stack of two Post-It notes to the bottom edge of the trackpad. Run a finger over the top case and trackpad to verify the trackpad is flush with the Post-It note.



8. If the trackpad is correctly aligned, continue with step 9. If the trackpad is higher than the top case, remove the screws and replace the shims with the thinner 0.075 mm shims. If the trackpad is lower than the top case, remove the screws and

replace the shims with the thicker 0.175 mm shims.

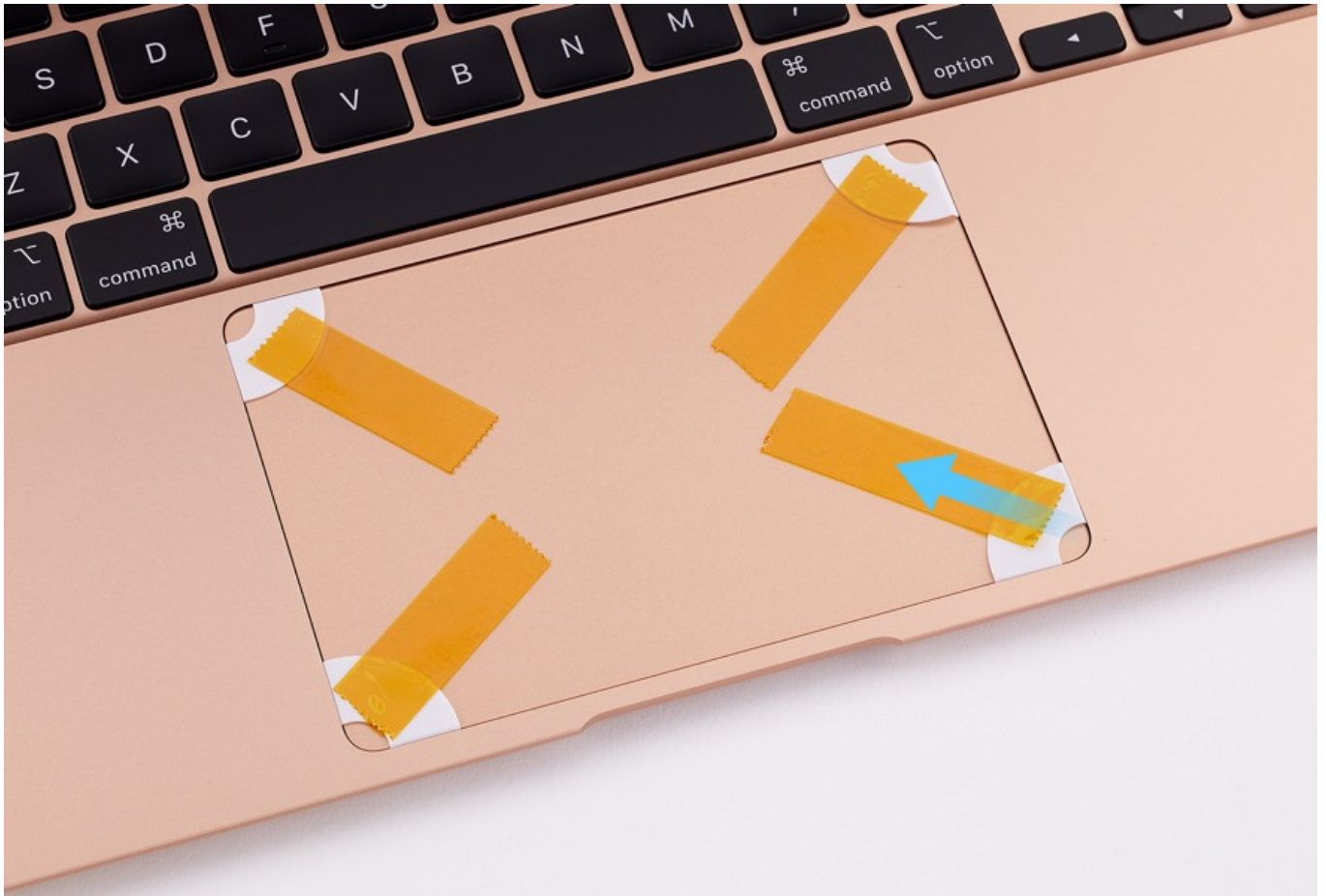
9. Place the unit so the display is over the table edge. Insert a T5 bit into the 0.3–1.2 Nm torque driver. Set the driver to 0.35 Nm. Tighten the middle screw to 0.35 Nm.

- T5: 923-03002



10. Insert the T5 bit into the adjustable 10–34 Ncm torque driver. Set the torque value to 16 Ncm. Tighten the eight outer screws to 16 Ncm.

11. Turn the computer over and use a black stick to lift off the gap offset tools and the Kapton tape.



12. Turn the computer over and reconnect the flex connector to the topcase and gently adhere it to the battery.

13. Reconnect the IPD flex connector to the logic board.

14. Reinstall the [bottom case](#).

15. Run the appropriate [AST 2 diagnostic suites](#) (TP1909).

# MacBook Air (M1, 2020) Input Device (IPD) Flex Cable

## First Steps



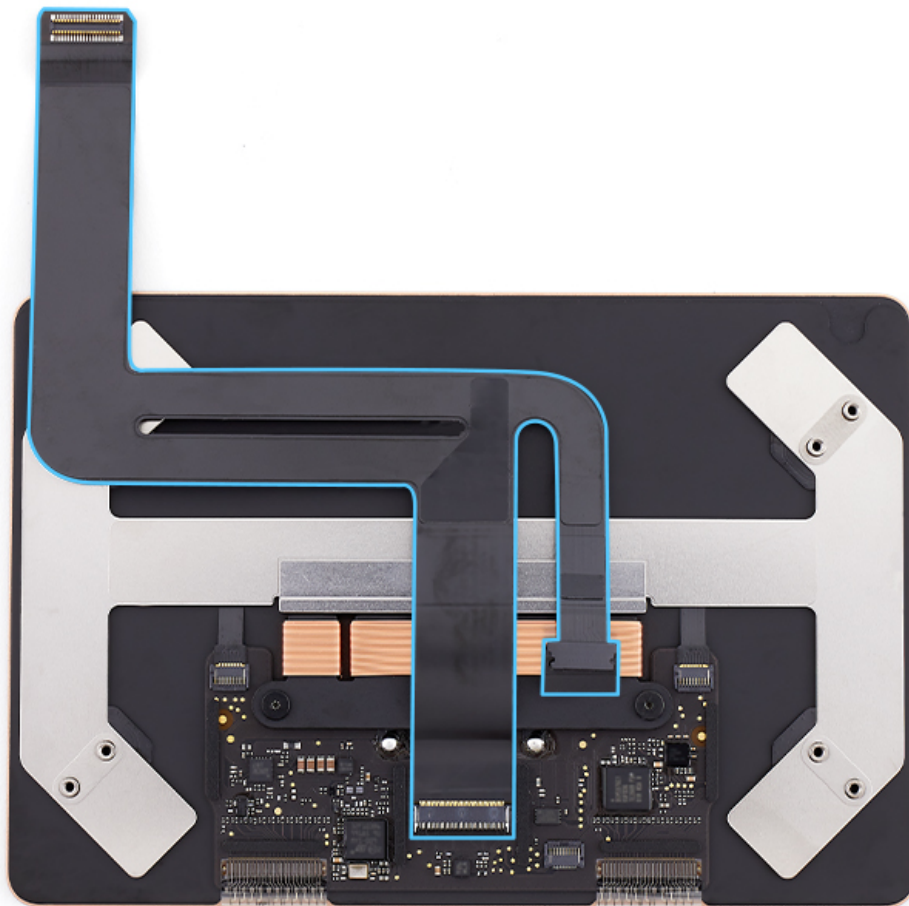
### Warning:

- To avoid damaging parts, attach the battery cover and disengage battery power immediately after removing the bottom case.
- Do not apply external power while the computer is under repair.

### Important:

- Only Apple-certified technicians should perform this procedure. For more information, refer to [OP1859: About Apple service certifications](#).
- Wear an ESD wrist strap and take precautions to avoid ESD.

- [Bottom Case](#)
- [Trackpad](#)



## Tools

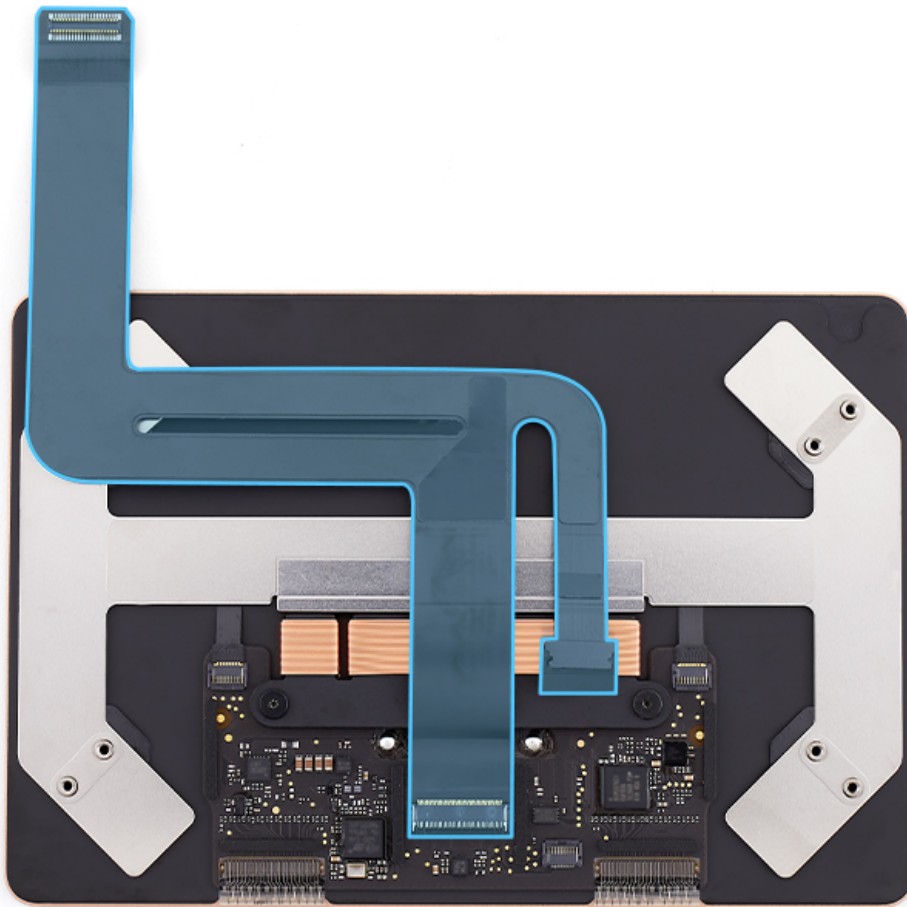
1. Black stick

1

## Steps For Removal

**Note:** If reinstalling the trackpad, do not remove the IPD flex cable from the trackpad unless it is damaged. If installing a new trackpad, replace the IPD flex cable with a new one that is included with the replacement part.

1. Open the locking lever and disconnect the IPD flex cable from the trackpad.

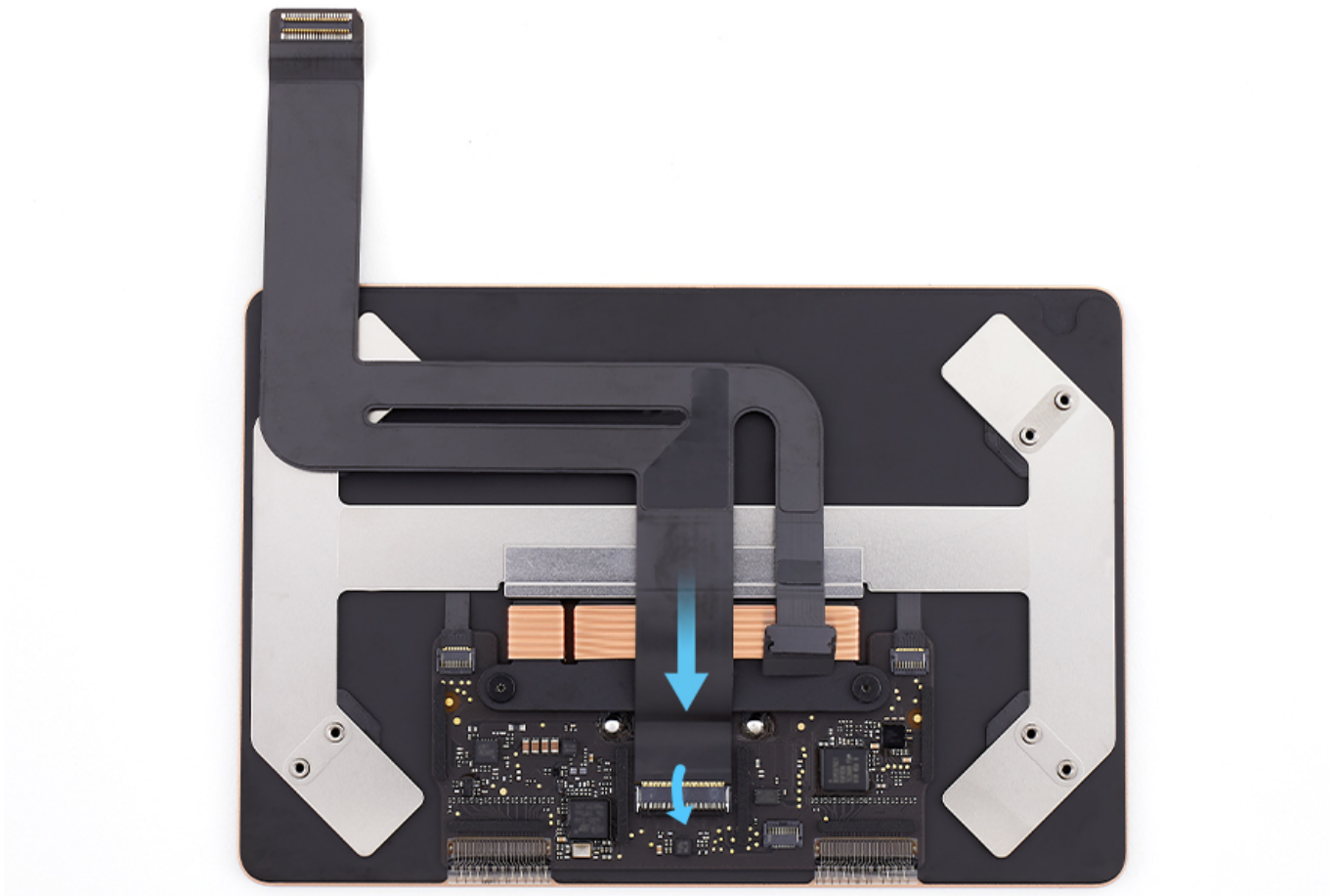


2. Leave the locking lever open in its upright position for reinstallation.

## Steps For Reassembly

1. Insert the IPD flex cable into the connector on the replacement trackpad. Verify the cable is inserted completely. Close the locking lever.





2. **Important:** Run the appropriate [AST 2 diagnostic suites](#) (TP1909).

# MacBook Air (M1, 2020) Speakers

## First Steps



### Warning:

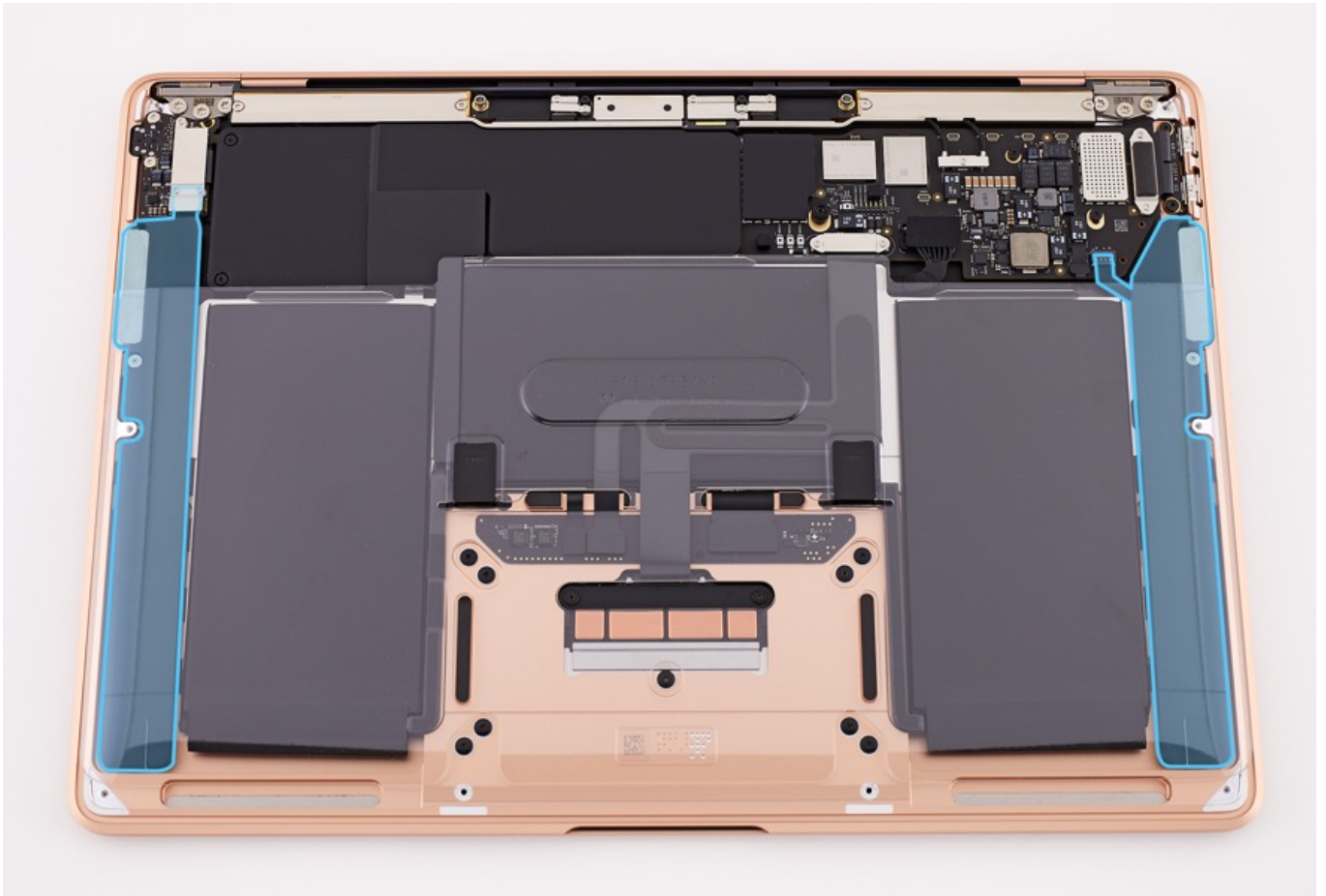
- To avoid damaging parts, attach the battery cover and disengage battery power immediately after removing the bottom case.
- Do not apply external power while the computer is under repair.

### Important:

- Only Apple-certified technicians should perform this procedure. For more information, refer to [OP1859: About Apple service certifications](#).
- Wear an ESD wrist strap and take precautions to avoid ESD.

### Remove:

- [Bottom Case](#)



## Tools

1. Battery/speaker adhesive kit (076-00467) Kit is included with replacement speakers, battery, and top case.
2. Torx T3 screwdriver (magnetized)
3. ESD-safe flat-nosed tweezers
4. Black stick





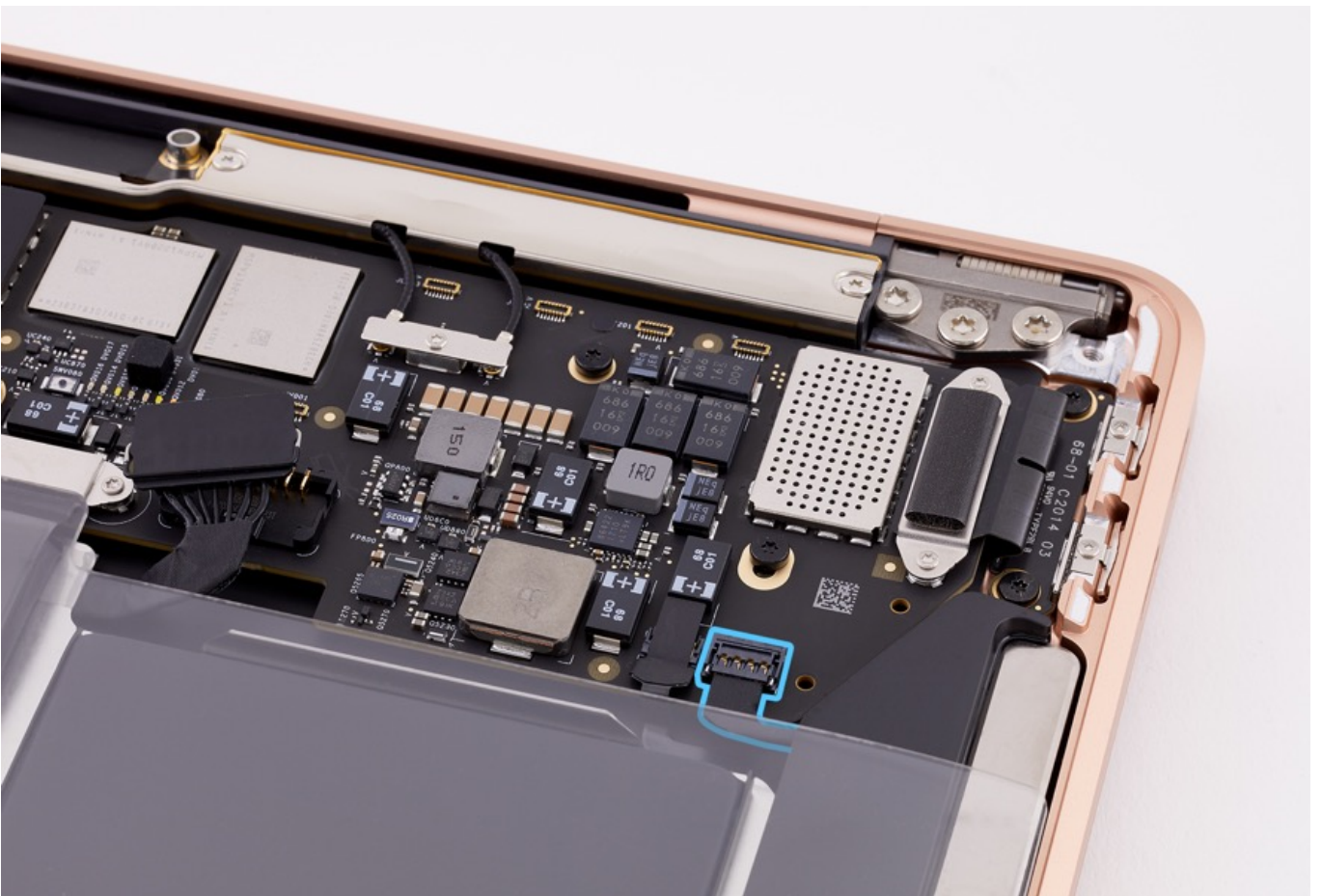
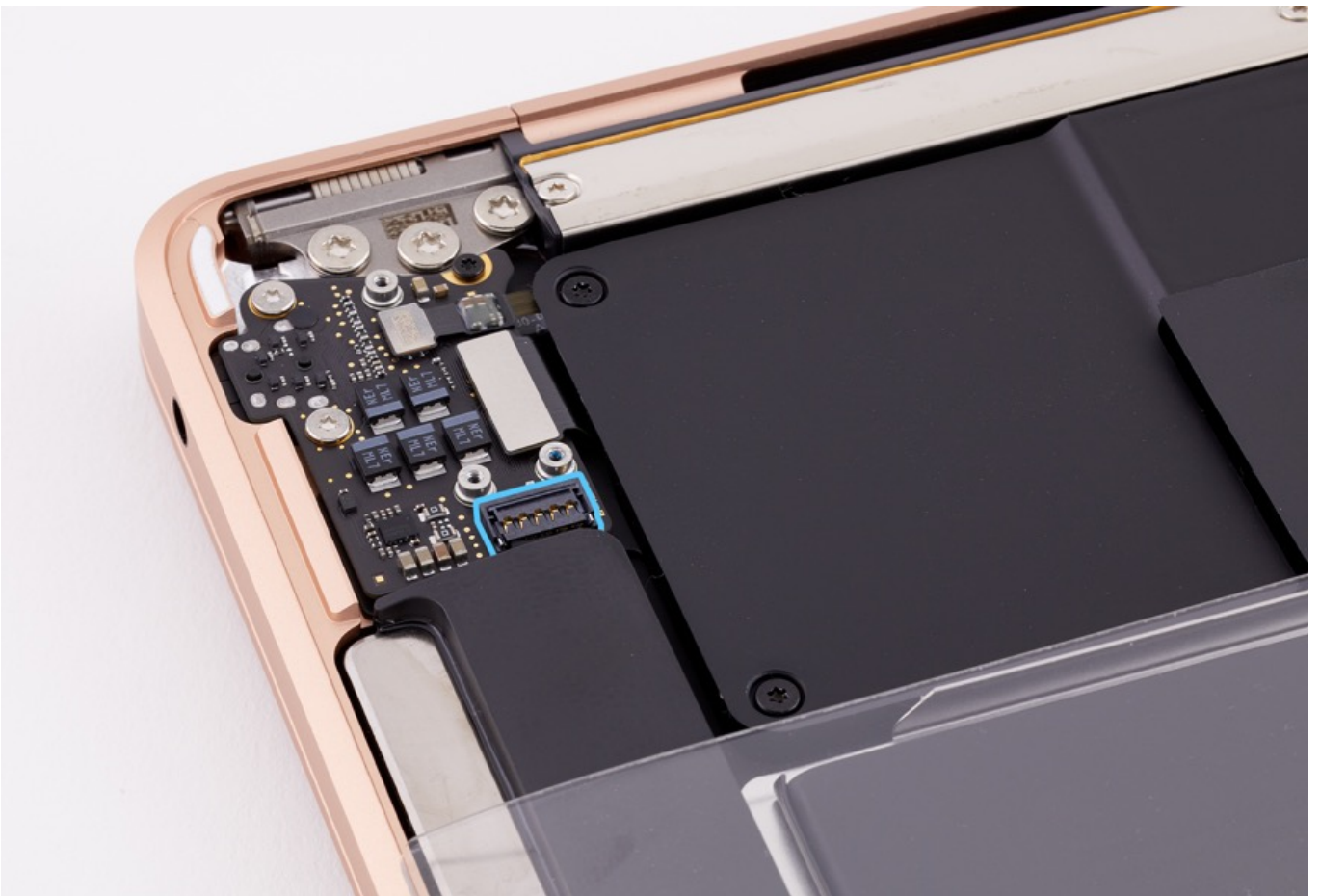
## Steps For Removal

1. Remove three T3 screws from the audio board cowling. Remove the cowling and save for reuse.

- T3: 923-04003



2. Disconnect the speaker flex cables; the right speaker from the audio board and the left speaker from the logic board.



3. Lift the battery cover up slightly on each side to reach the speaker screws. Be sure the battery cover clips remain in place.



4. Remove the T3 speaker screw.

- T3: 923-03850



5. Lift the battery cover up slightly to reach the speaker adhesive pull tab. Be sure the battery cover clips remain in place. Grasp the pull tab with flat-nosed, ESD-safe tweezers.





6. Extend the adhesive strip past the battery cover and twist the tweezers to wrap the speaker adhesive tab around it. As the speaker adhesive strip extends, continue to twist and slowly pull it with the tweezers.

**Important:** Avoid pulling the adhesive strip against the edge of the speaker well or the strip may break.



**Note:** If the adhesive strip breaks, then attempt to retrieve the rest of the strip with ESD-safe tweezers. If that is unsuccessful, replace the top case.

7. Lift the speaker toward the up and out of the top case.



8. Repeat the steps to remove the left speaker.

## Steps For Reassembly

### Important:

- Speakers must be replaced as a pair.
- If installing replacement speakers, the pressure-sensitive adhesive (PSA) will be preinstalled.
- If reinstalling the original speakers, you will have to adhere the PSA to the back of each speaker.
- Check the speaker well for adhesive. Clean the area with an IPA wipe only if there is adhesive residue present.

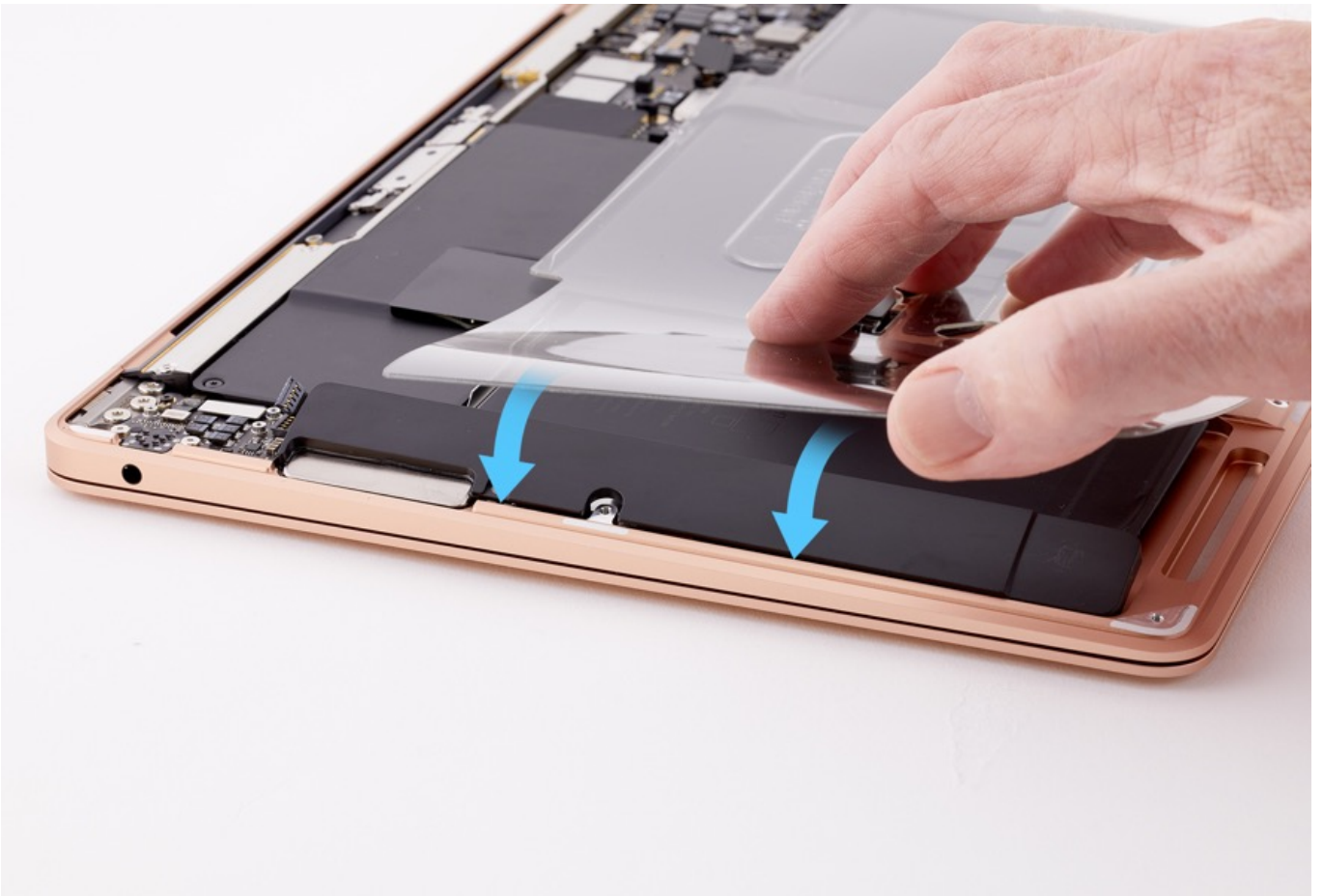
### Note:

- If installing new speakers, peel the backing off of the PSA that is preapplied to the back of the speaker.
- If reinstalling speakers, remove the backing from the included PSA strips.



1. Rotate the speaker slightly and tuck it into position in the top case, and gently press down on both ends of the speaker for a few seconds to adhere the speaker to the top case.





2. Fold the pull tab back onto the bottom of speaker.



3. Reinstall the T3 speaker screw.

- T3: 923-03850



4. Repeat these steps to reinstall the left speaker.
5. Reinstall the [bottom case](#).
6. **Important:** Run the appropriate [AST 2 diagnostic suites](#) (TP1909).

# MacBook Air (M1, 2020) Battery

## First Steps



### Warning:

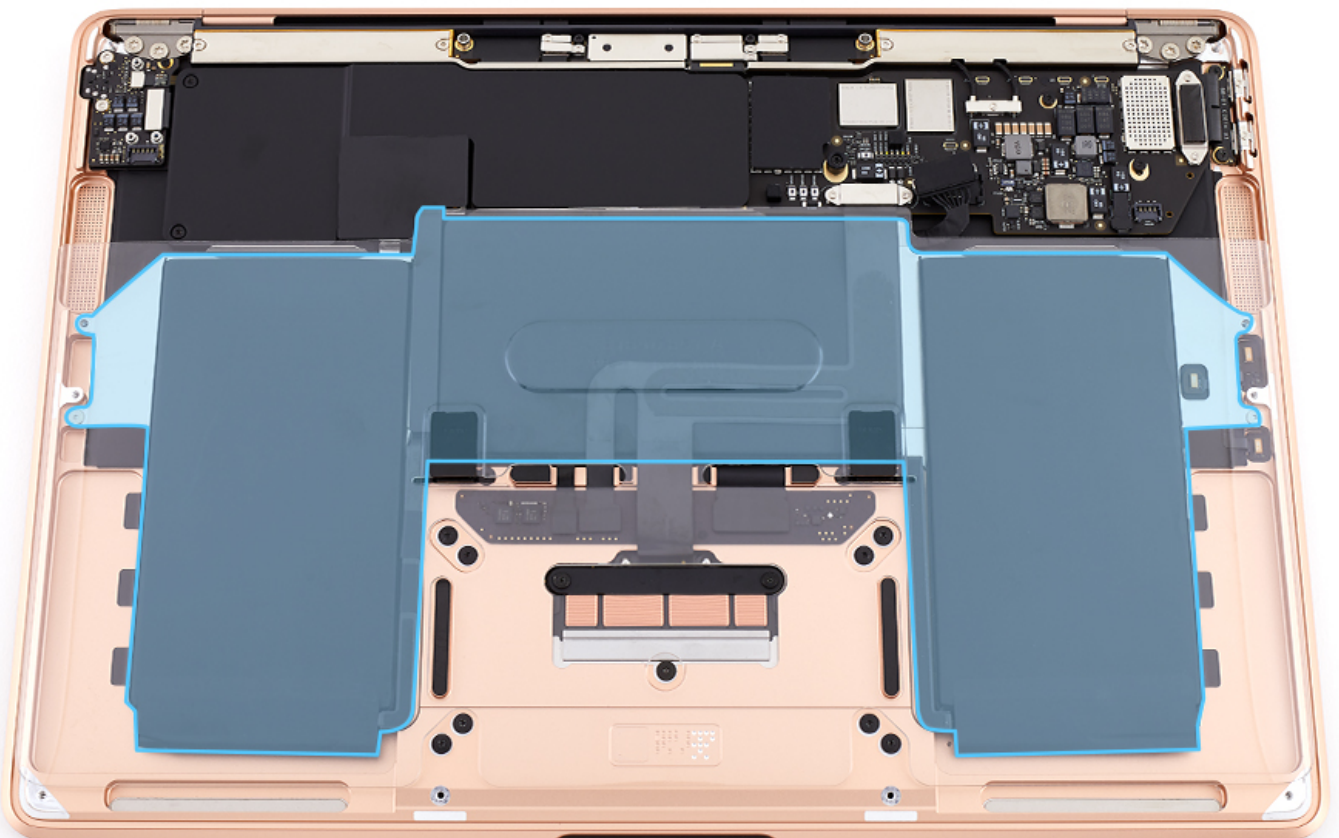
- To avoid damaging parts, attach the battery cover and disengage battery power immediately after removing the bottom case.
- Do not apply external power while the computer is under repair.

### Important:

- Only Apple-certified technicians should perform this procedure. For more information, refer to [OP1859: About Apple service certifications](#).
- Wear an ESD wrist strap and take precautions to avoid ESD.

### Remove:

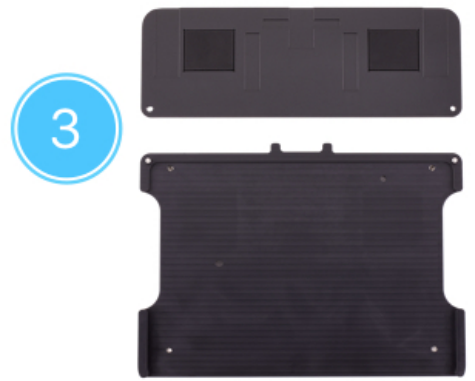
- [Bottom Case](#)
- [Speakers](#)



## Tools

1. Battery/speaker adhesive kit (076-00467) Kit is included with replacement speakers, battery, and top case.
2. iPhone Display Press (661-08916)
3. Battery press plate and support frame (923-03007)
4. Flat-nosed ESD-safe tweezers
5. Torx T3 driver
6. Guide pins (included with replacement battery)





## Steps For Removal

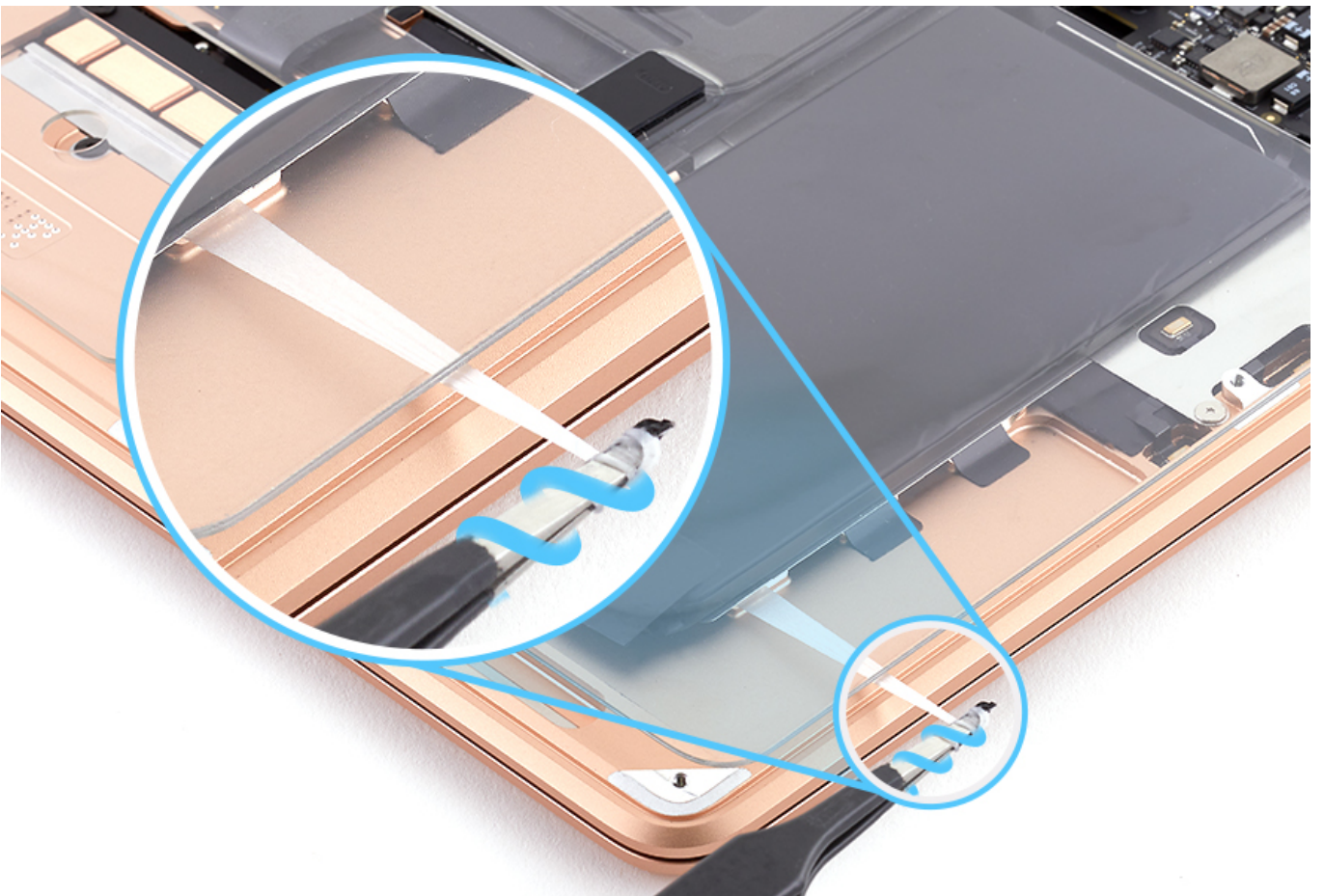
1. Lift up the battery cover to allow space to reach the battery tabs. Be sure the battery cover clips remains in place.



2. Grasp the tab with ESD-safe, flat-nosed tweezers.;



3. Gently pull the tab towards you and once it clears the battery cover, begin to slowly twirl the adhesive around the tweezers. Continue this process until the adhesive is removed from underneath the battery. Repeat this procedure for all six tabs.



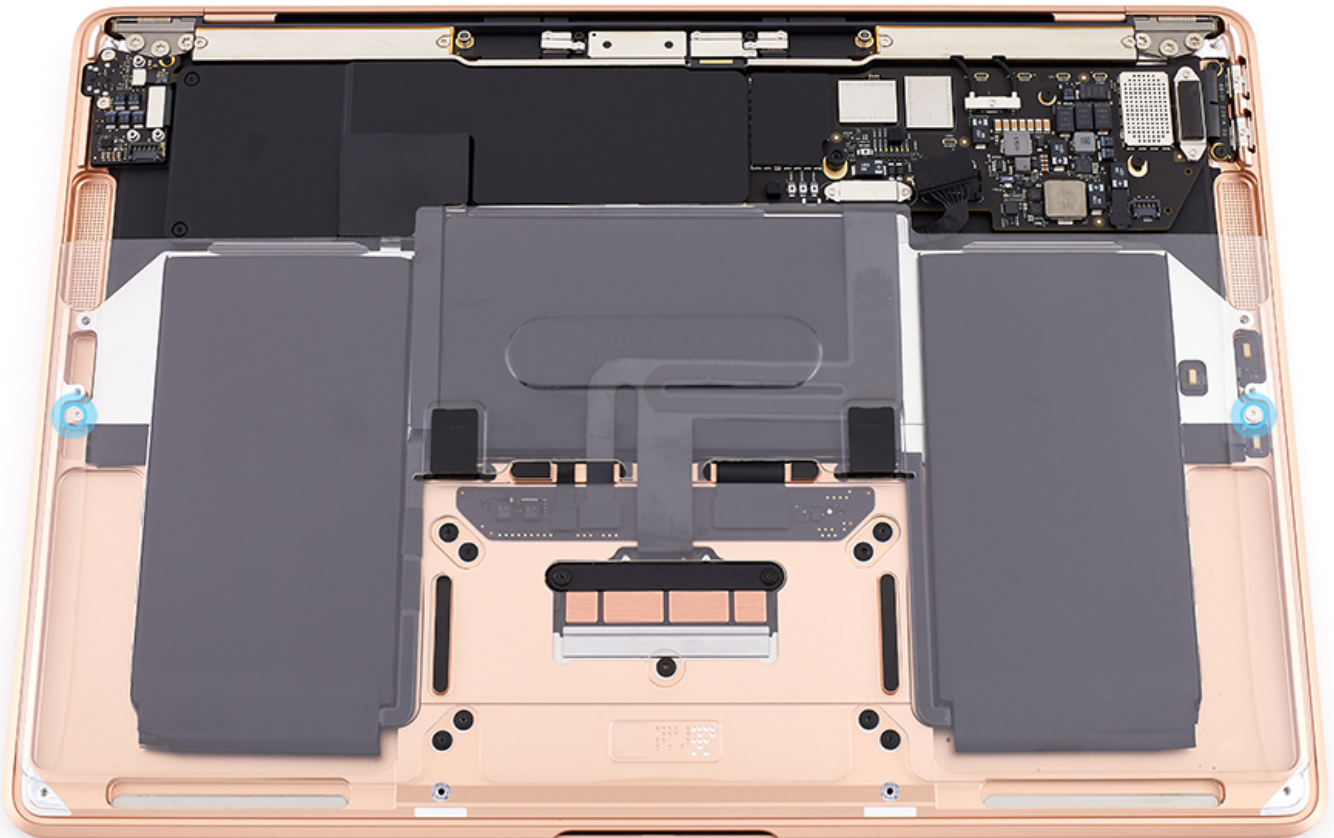




**Caution:** This procedure requires slow, steady movements. Take your time. Pulling the adhesive too quickly can cause the adhesive to break, resulting in a more difficult repair or a whole top case replacement.

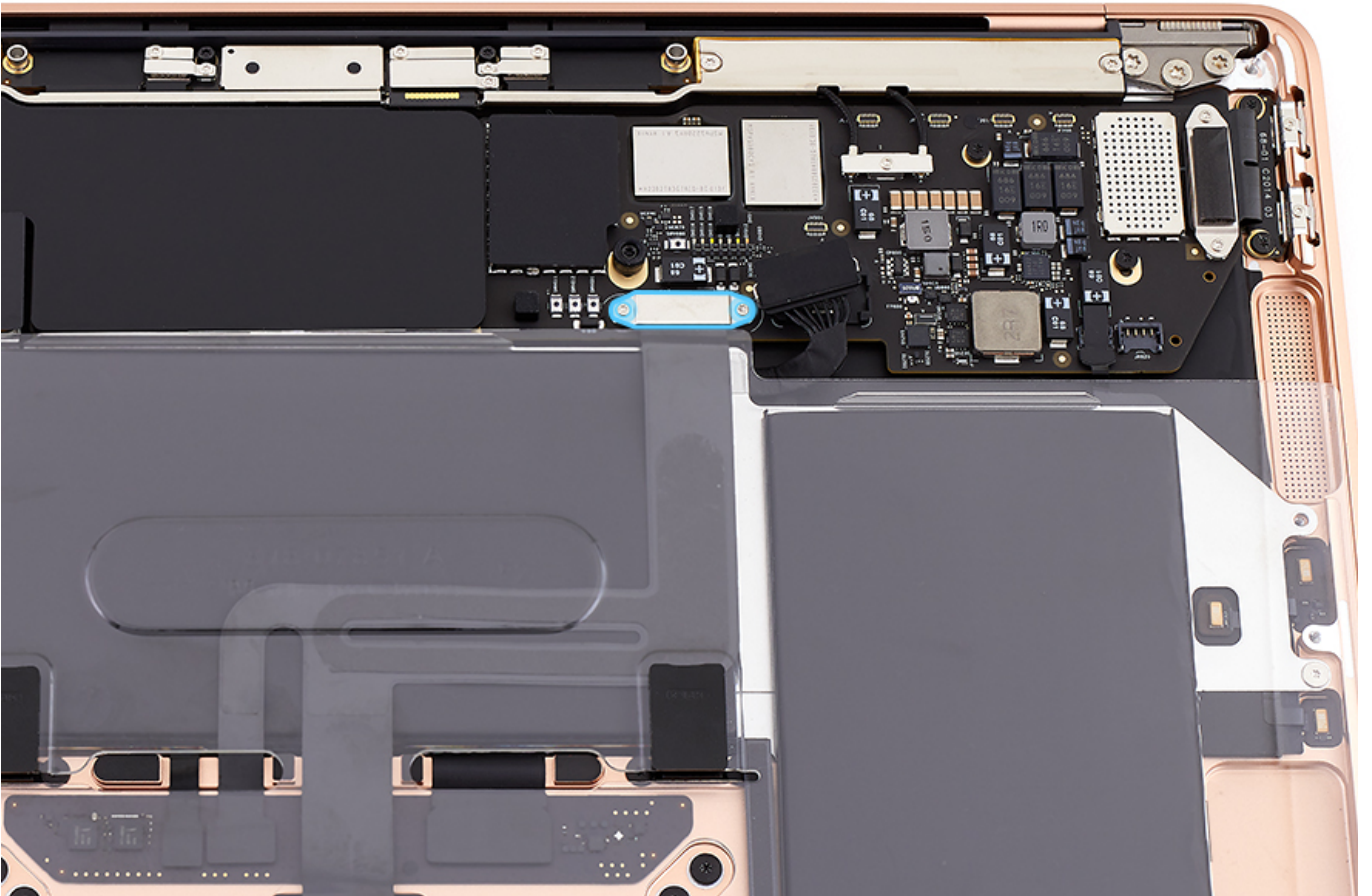
4. Lift the battery cover and remove the two T3 screws from each side of the battery.

- T3: 923-03680

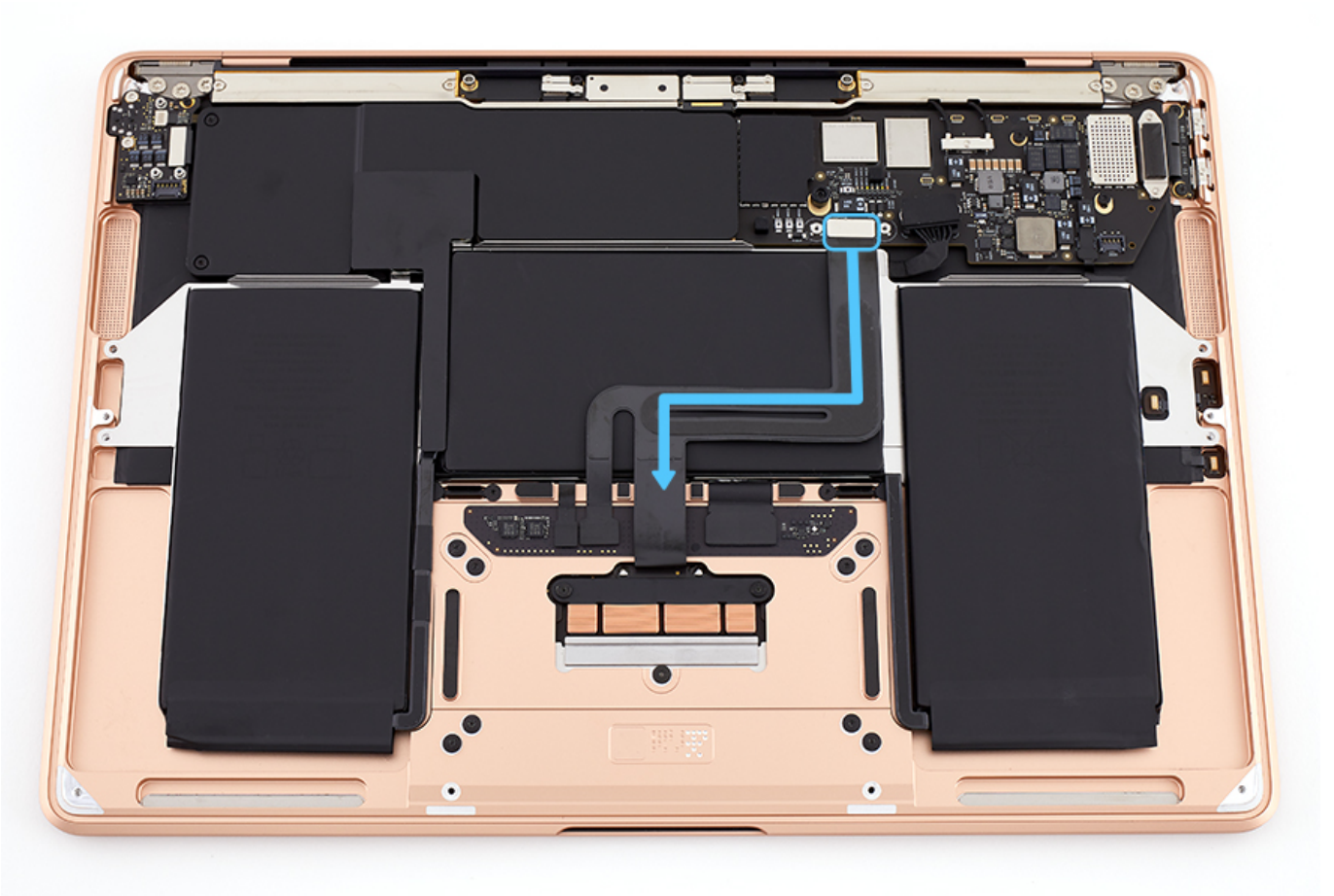


5. Remove the two T3 screws from the IPD flex cable cowling and remove the cowling. Save for reuse.

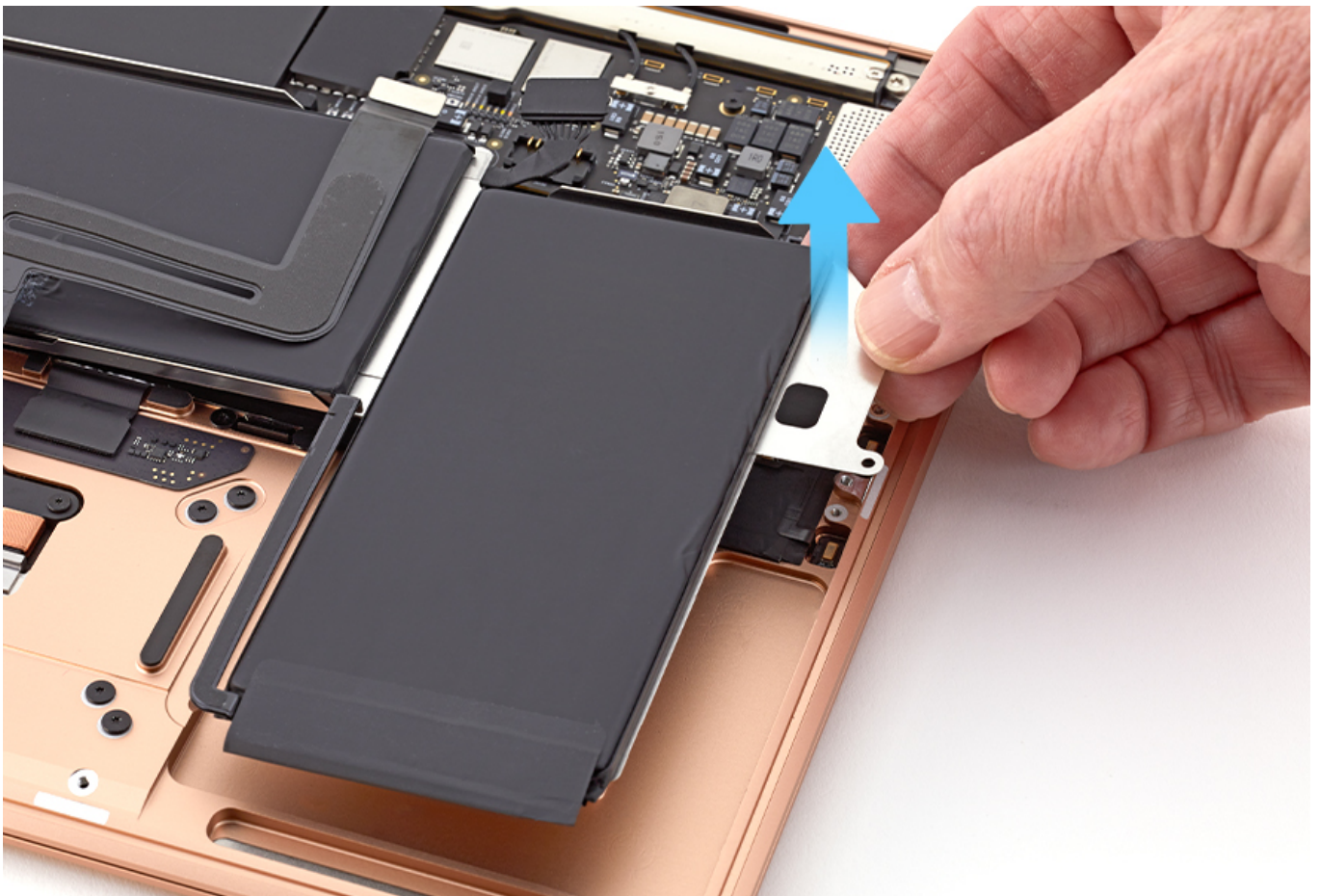




6. Disconnect the IPD flex cable from the logic board and gently loosen the adhesive that attaches the IPD flex to the battery.



7. Grasp the battery at the corners and lift out of the top case.



**Caution:** The battery sits on a metal tray that is part of the battery assembly. Do not attempt to remove the battery from the tray.

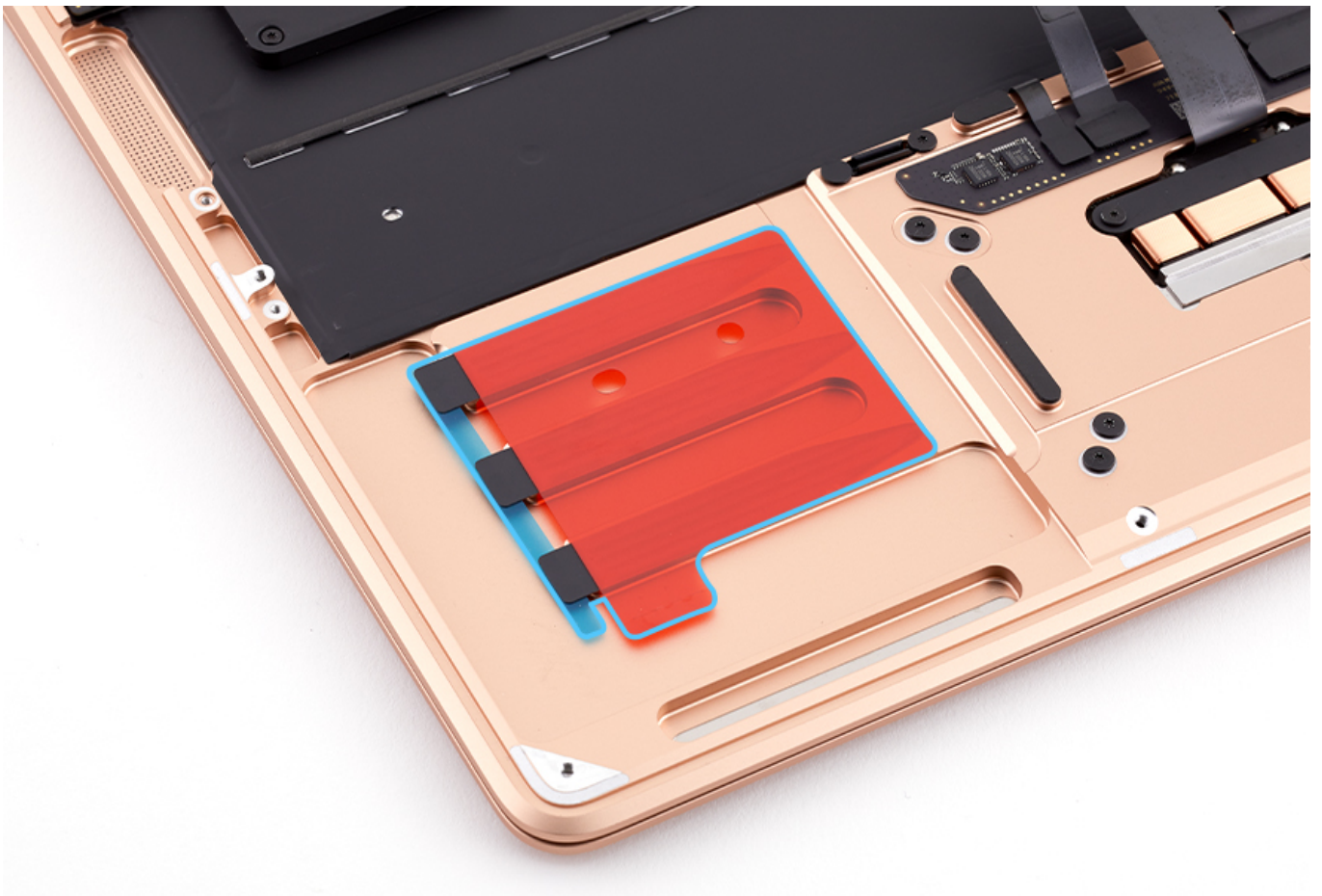
### Steps For Reassembly

1. Check the battery well for adhesive residue. Clean the area with an IPA wipe only if there is adhesive residue present.
2. Remove the square backing from the battery adhesive.

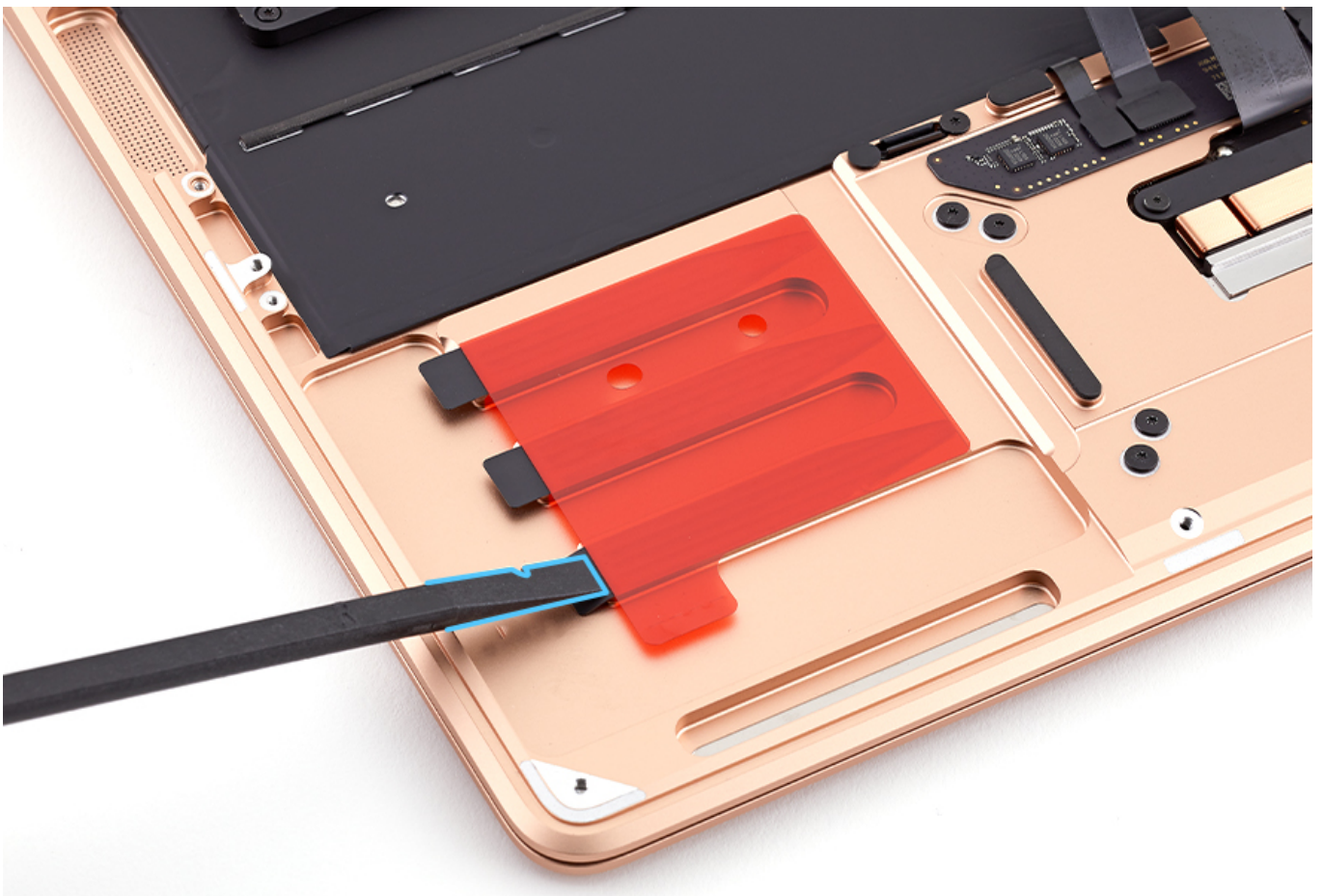




3. Align the adhesive strips on each side of the top case as shown in the image below. **Note:** Put adhesive in the top case, not on the back of the battery.



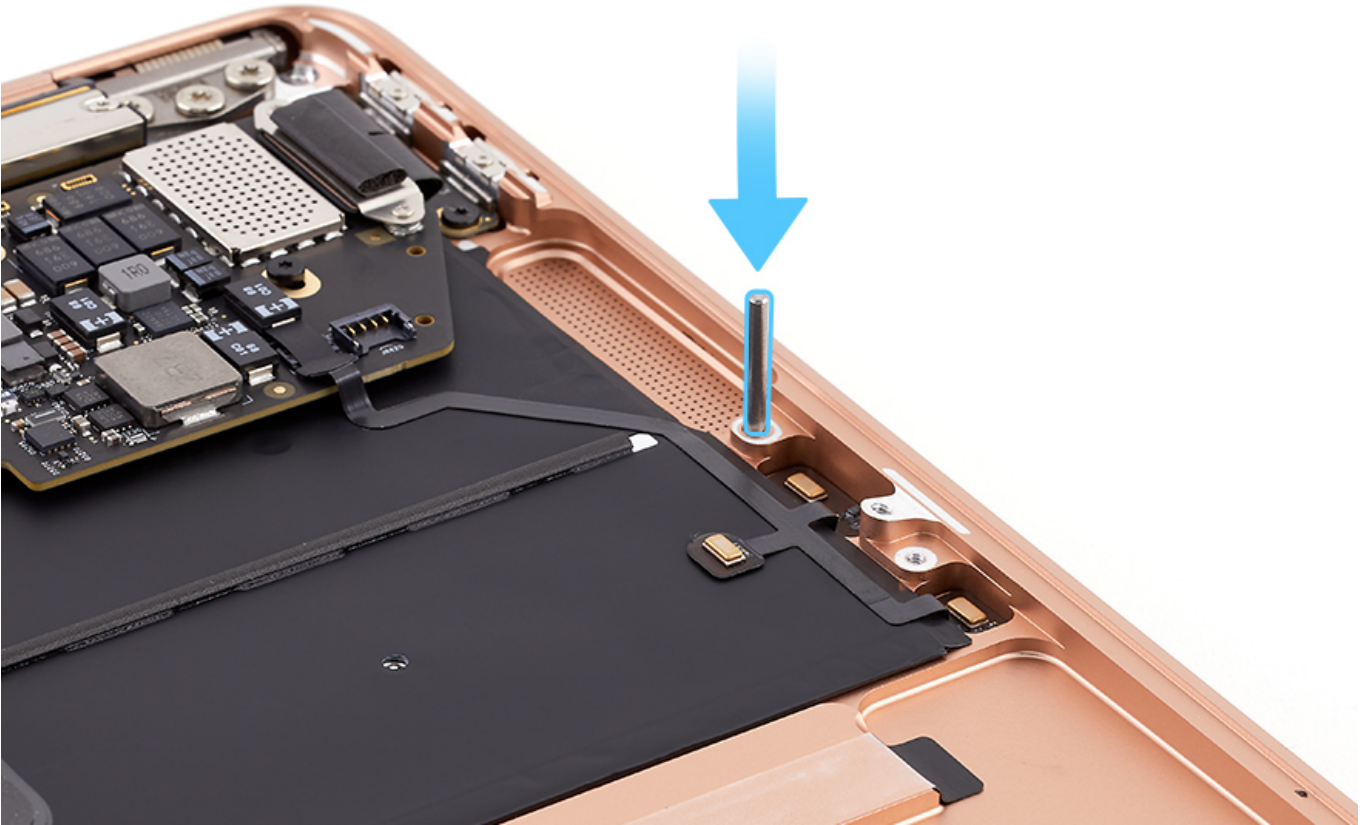
4. Remove the blue film and press all six tabs down.



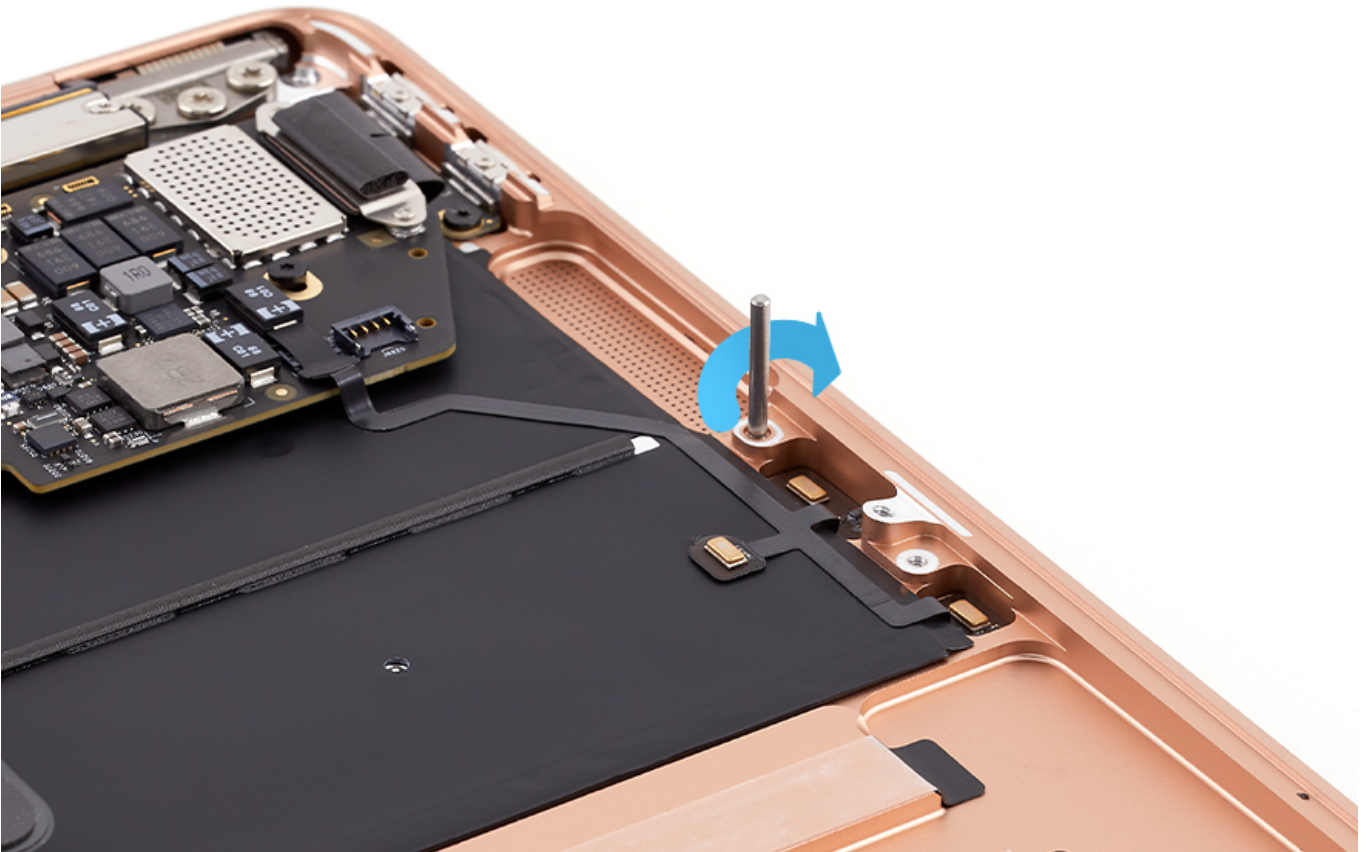
5. With your hands or a microfiber cloth, smooth down the red film to remove any air bubbles and to adhere the adhesive to the top case. Remove the red film.

6. Use tweezers to place the threaded end of a guide pin into one of the screw holes for alignment. Repeat on the other side.

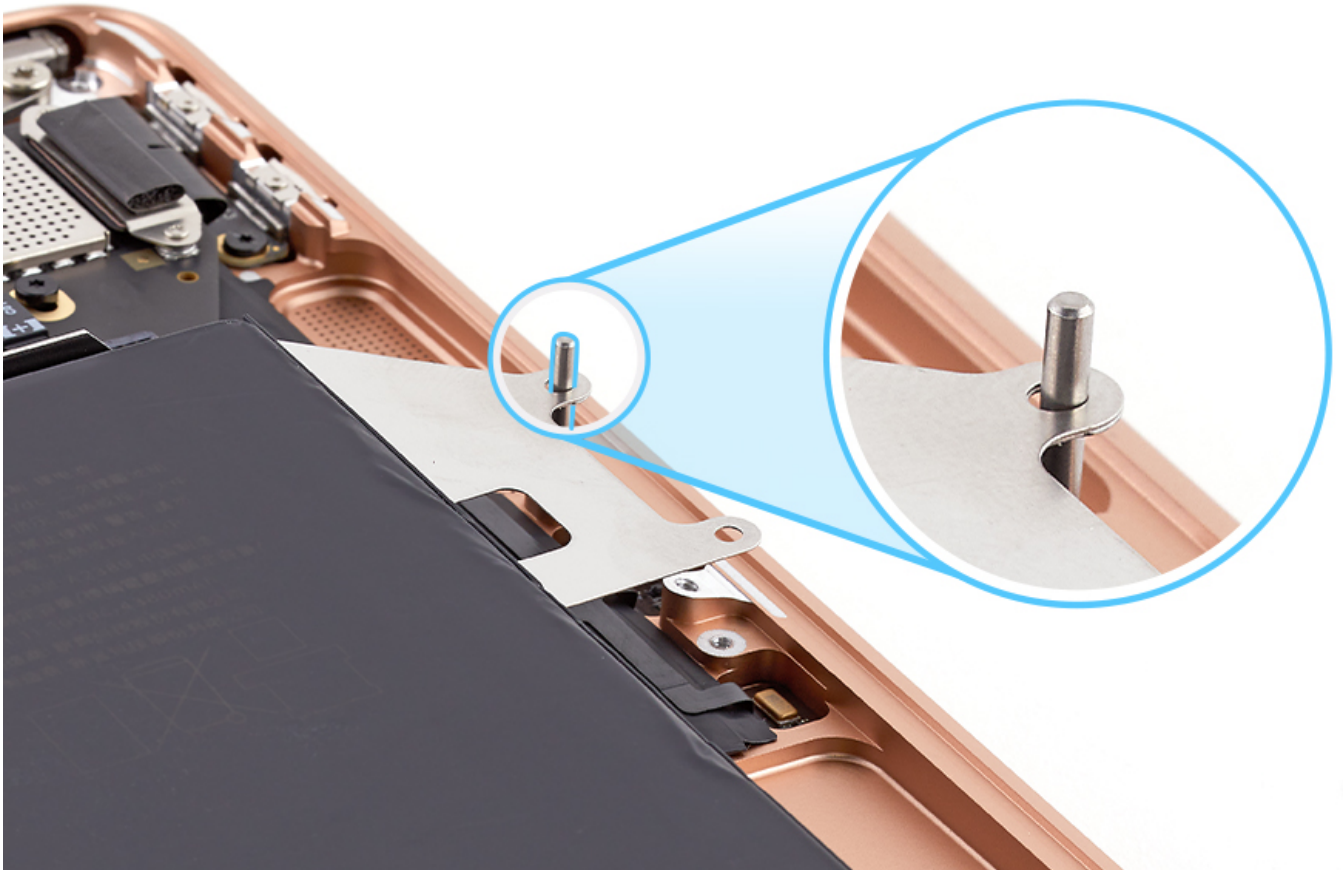




7. Turn the guide pins clockwise to screw them in.



8. Align the tabs on the metal tray over the guide pins and lower the battery. **Important:** Be sure not to trap the IPD flex under the battery.



9. Unscrew and remove the guide pins.

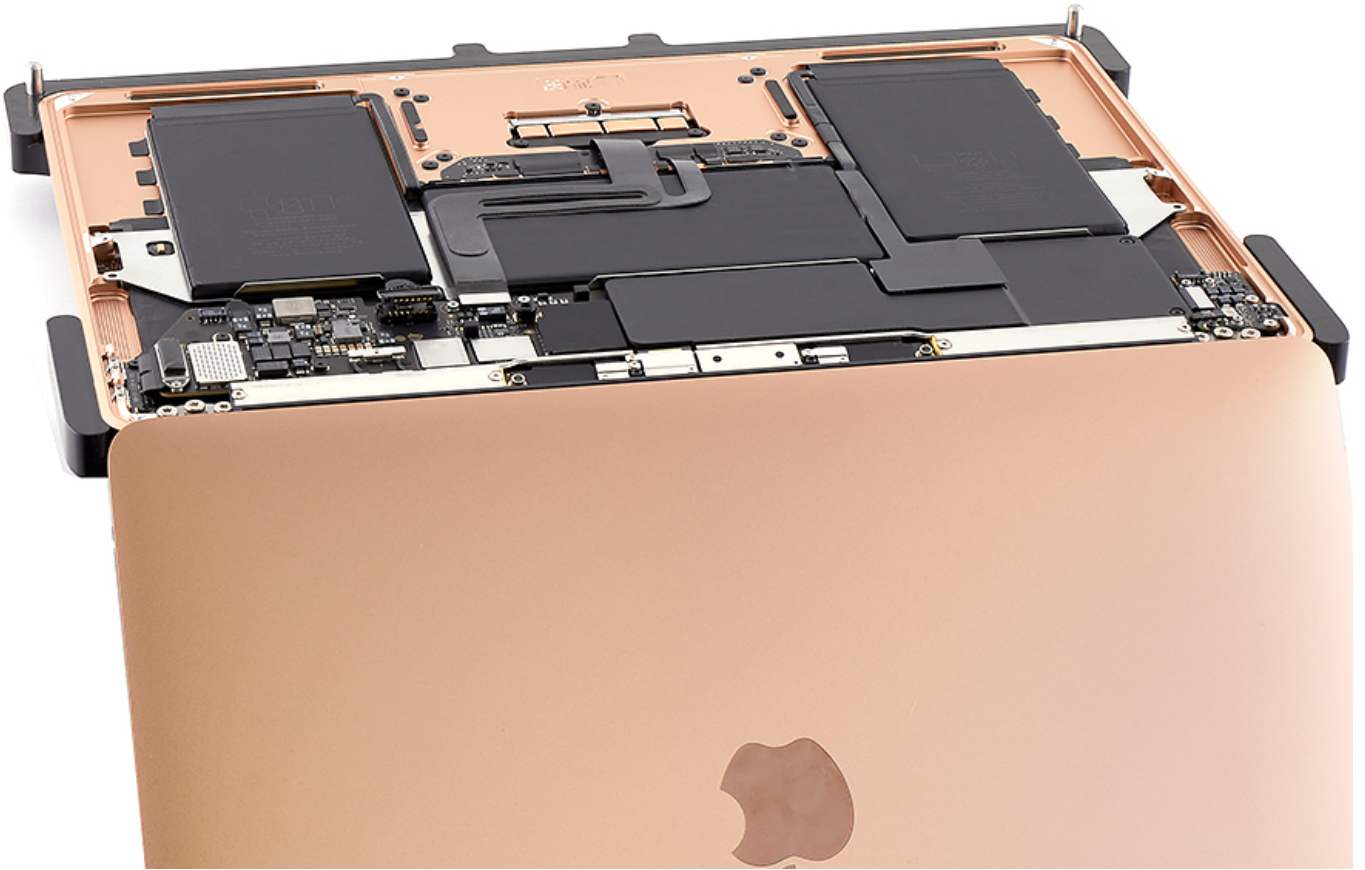
10. Reinstall the battery screws.

- T3: 923-03680



11. Place the computer in the support frame with the display hanging over the edge of the repair bench. Be sure the display is not touching the table edge to avoid scratching the display.



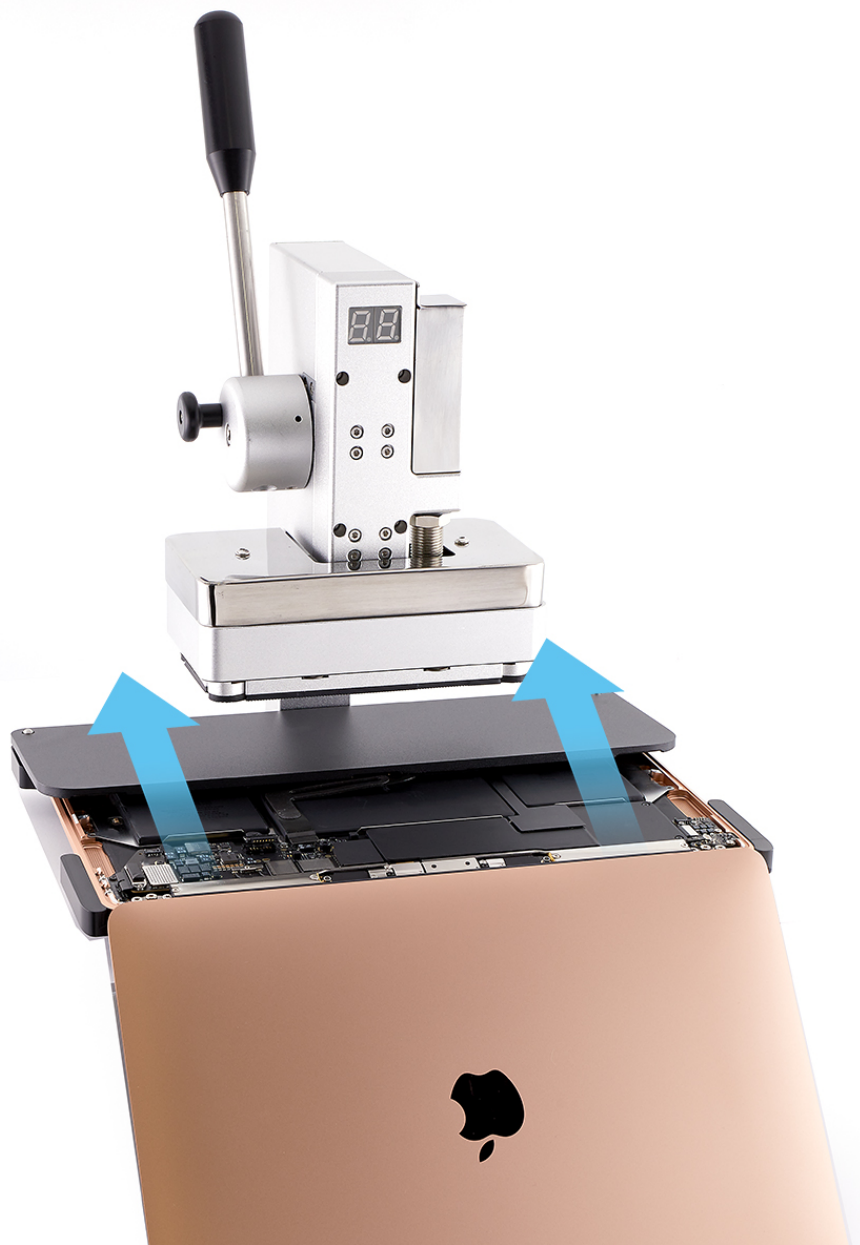


12. Gently adhere the IPD flex cable to the battery and make sure it is laying flat.

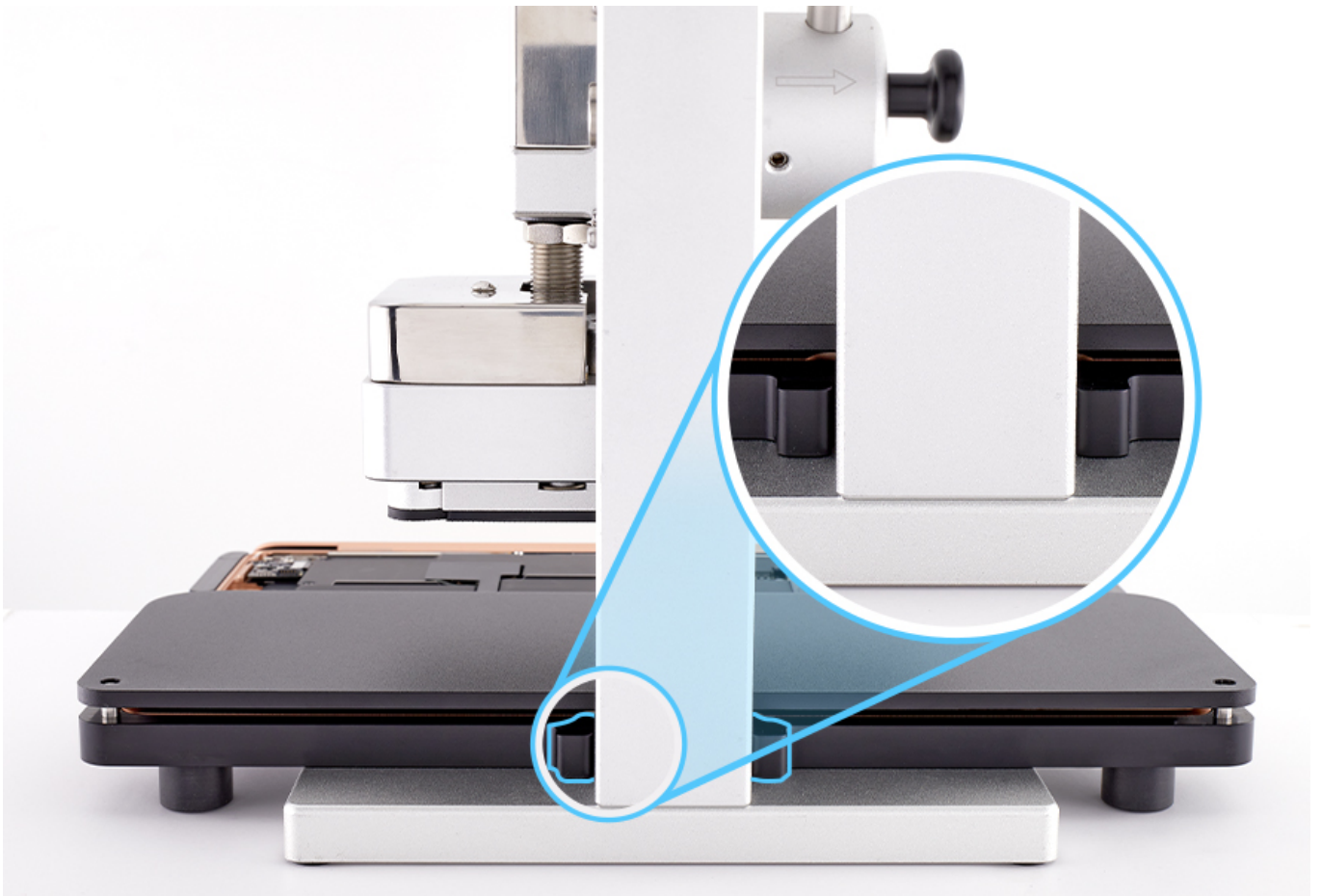
13. Line up the metal pins on the support frame with the holes on the press plate and place the press plate on top of the battery.



14. Place the support frame with the press plate in place into the display press.



15. Check the back of the display press to make sure the support frame is aligned correctly.

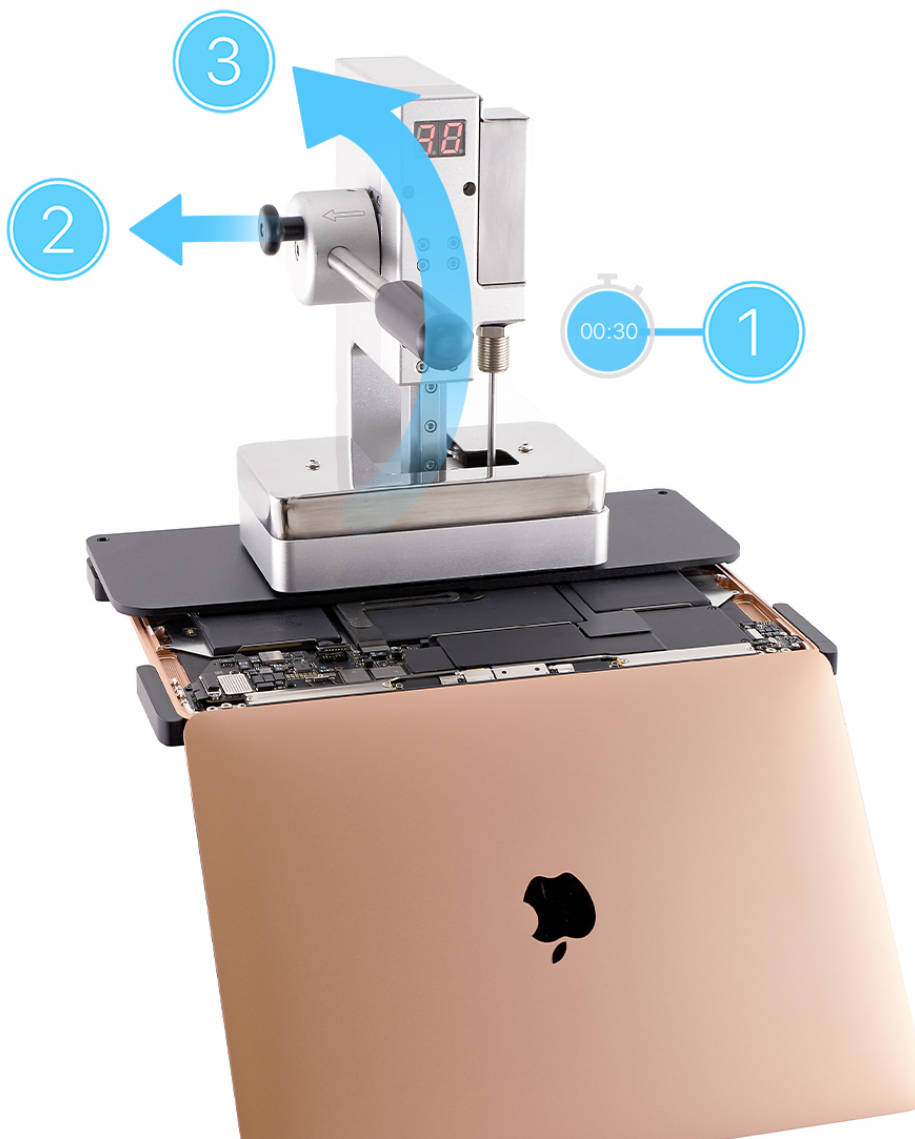


16. Pull down the lever until it locks.



17. The press will automatically count down 30 seconds (1). To release the lever, lower it slightly and pull the knob to unlock (2). Lift the lever (3).





18. Remove the support tray from the press and lift off the press plate. Attach the battery cover to continue the reassembly.
19. Connect the IPD flex cable to the logic board and reinstall the cowling and T3 screws.
20. Reinstall the [speakers](#) (RP1680). **Note:** Replacement speaker adhesive is included with a replacement battery. Speaker adhesive will have to be applied to the back of the speakers.
21. Reinstall the [bottom case](#) (RP1677).
22. **Important:** Run the appropriate [AST 2 diagnostic suites](#) (TP1909).

# MacBook Air (M1, 2020) Audio Board

## First Steps



### Warning:

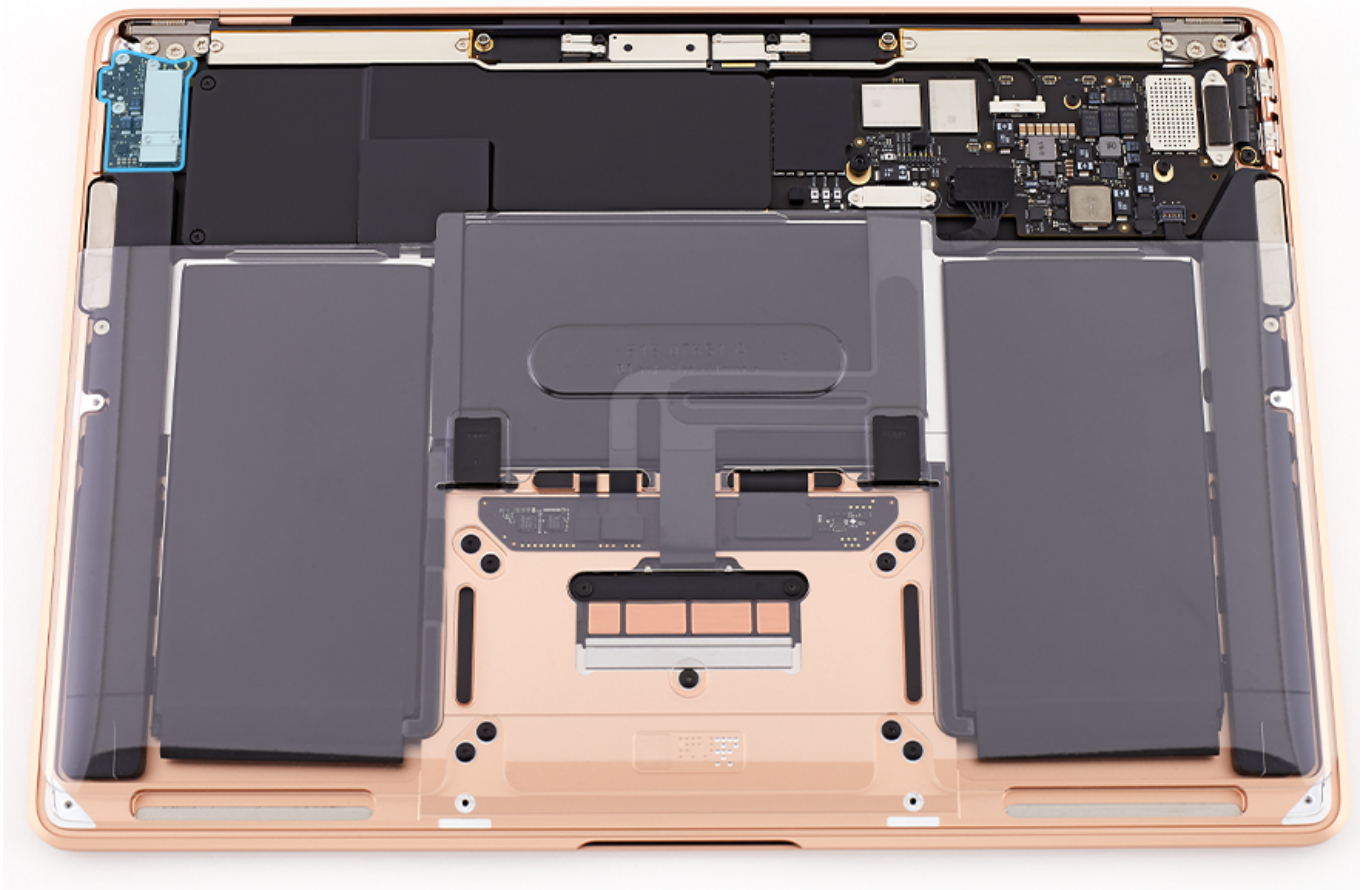
- To avoid damaging parts, attach the battery cover and disengage battery power immediately after removing the bottom case.
- Do not apply external power while the computer is under repair.

### Important:

- Only Apple-certified technicians should perform this procedure. For more information, refer to [OP1859: About Apple service certifications](#).
- Wear an ESD wrist strap and take precautions to avoid ESD.

### Remove:

- [Bottom Case](#)



## Tools

1. Torx T3 screwdriver (magnetized)
2. Torx T5 screwdriver (magnetized)
3. Kapton tape

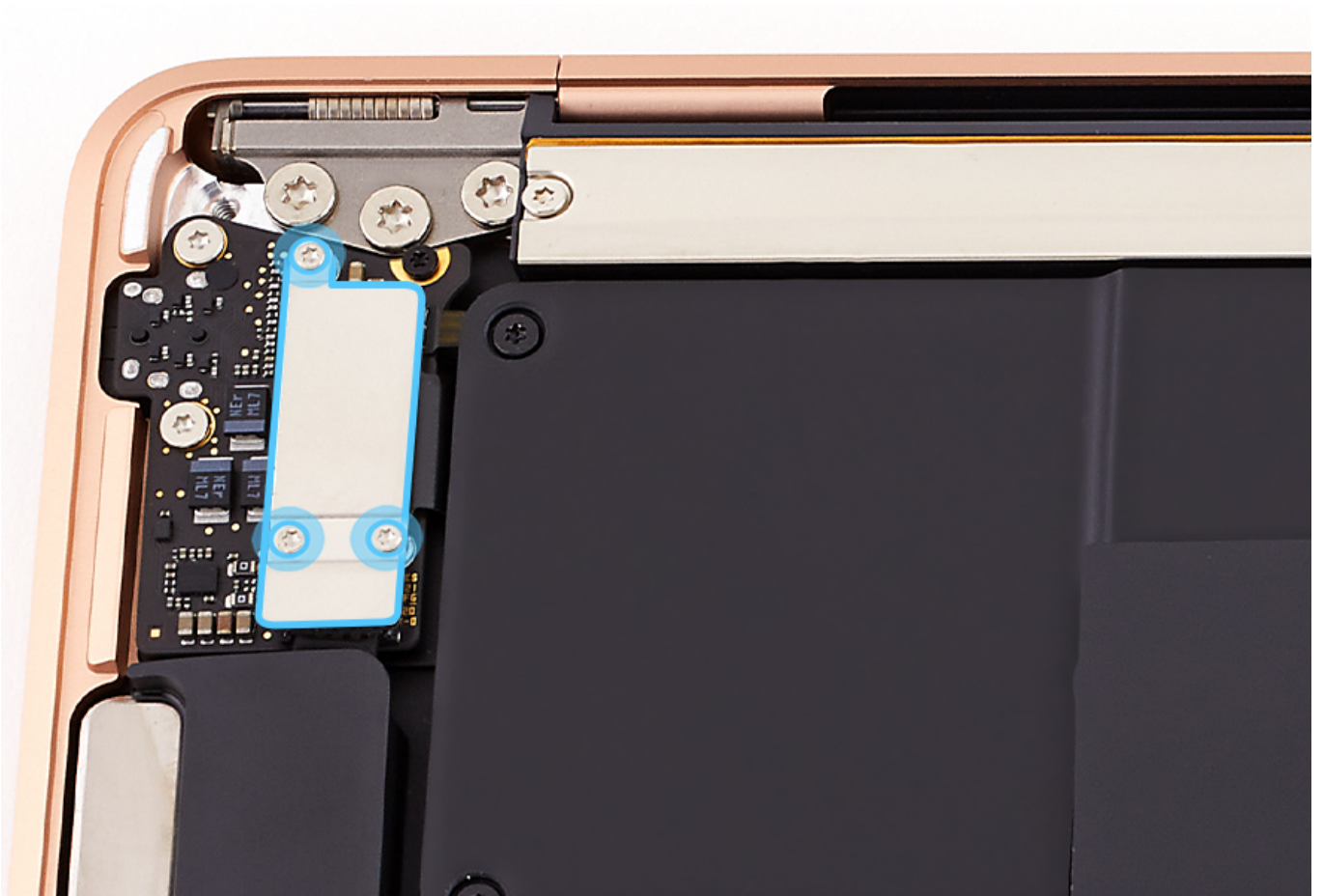




## Steps For Removal

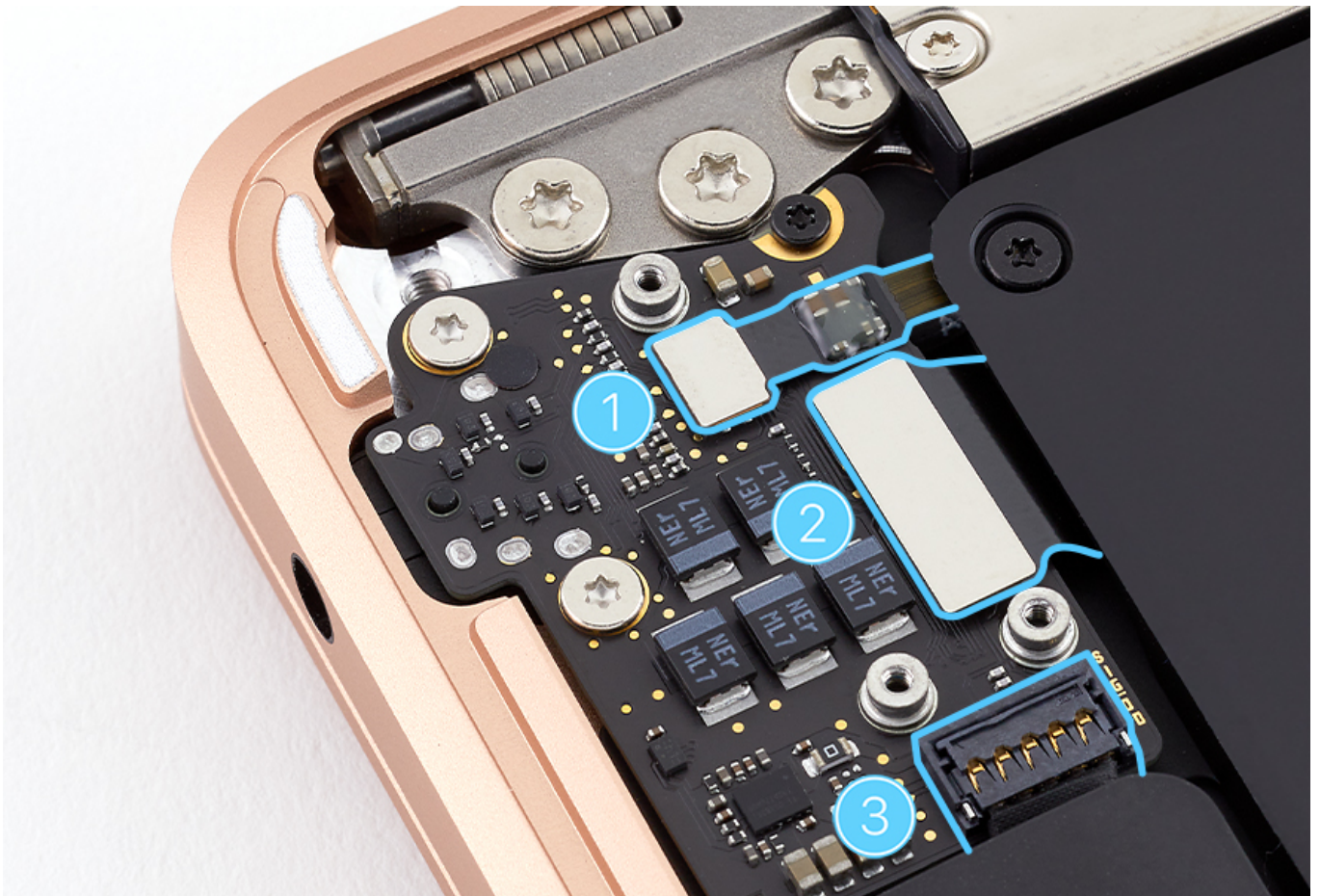
1. Remove three T3 screws from the cowling. Remove the cowling and save for reuse.

- T3: 923-04003



2. Disconnect three flex connectors.

- Touch ID flex connector (1)
- Audio board flex connector (2)
- Speaker flex connector (3)



3. Remove one black T3 screw and two silver T5 screws from the audio board.

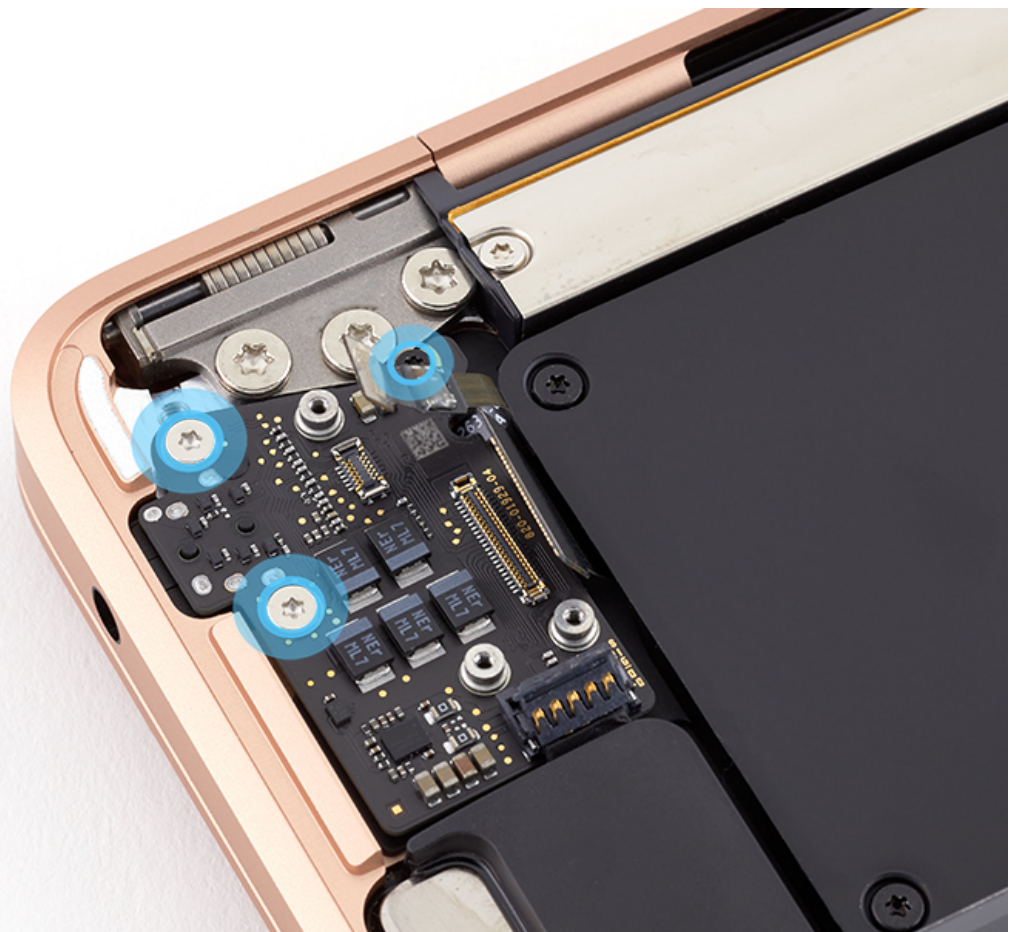
- T3: 923-02884



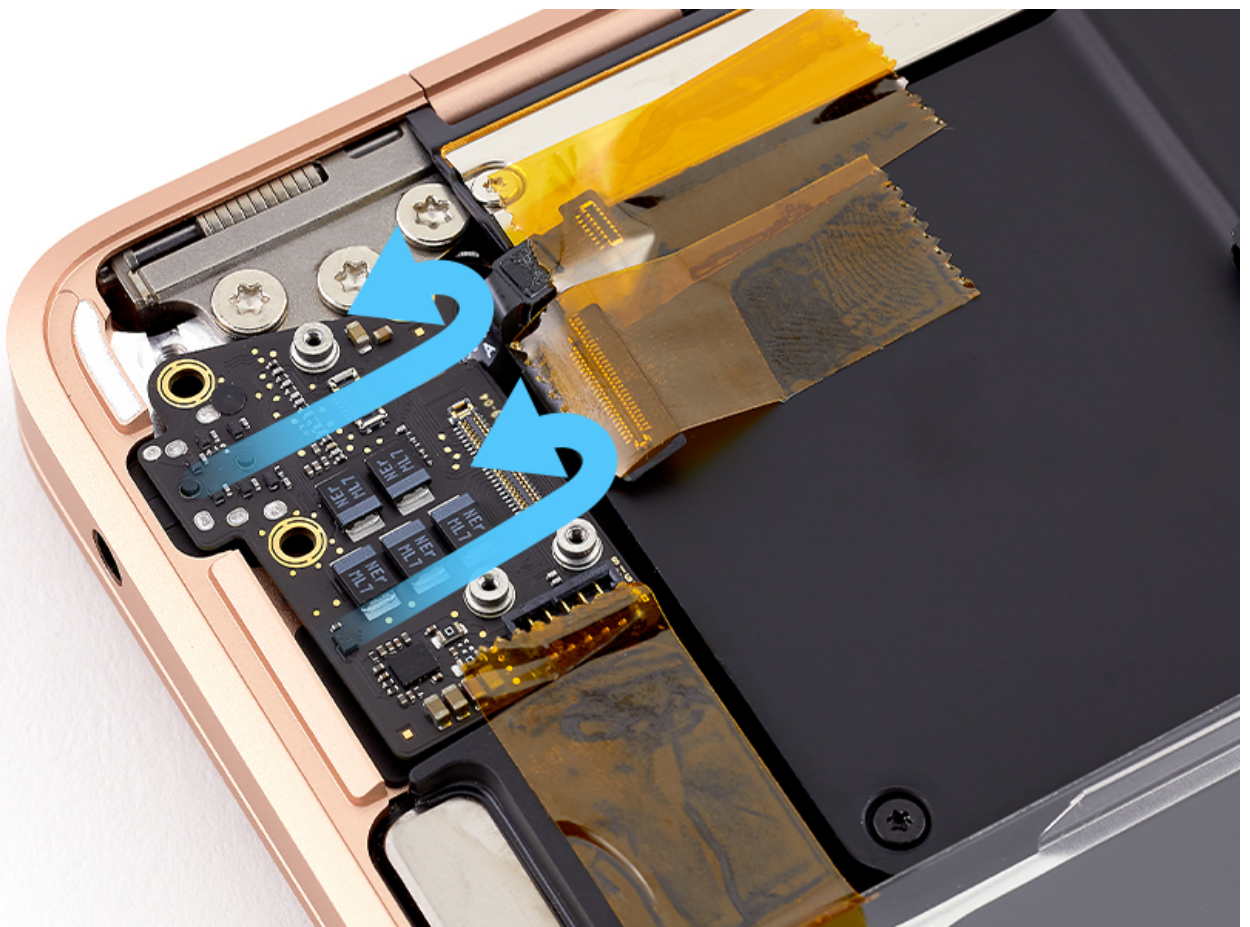
- T5: 923-04005







4. Lightly tape the flex cables out of the way with Kapton tape to avoid damaging them. Hold the audio board by the edges and lift it away from the port and out of the bottom case.



### Steps For Reassembly

**Note:** Be sure to order the correct part when replacing the audio board.

- Space Gray or Gold: 923-03672
- Silver: 923-03673

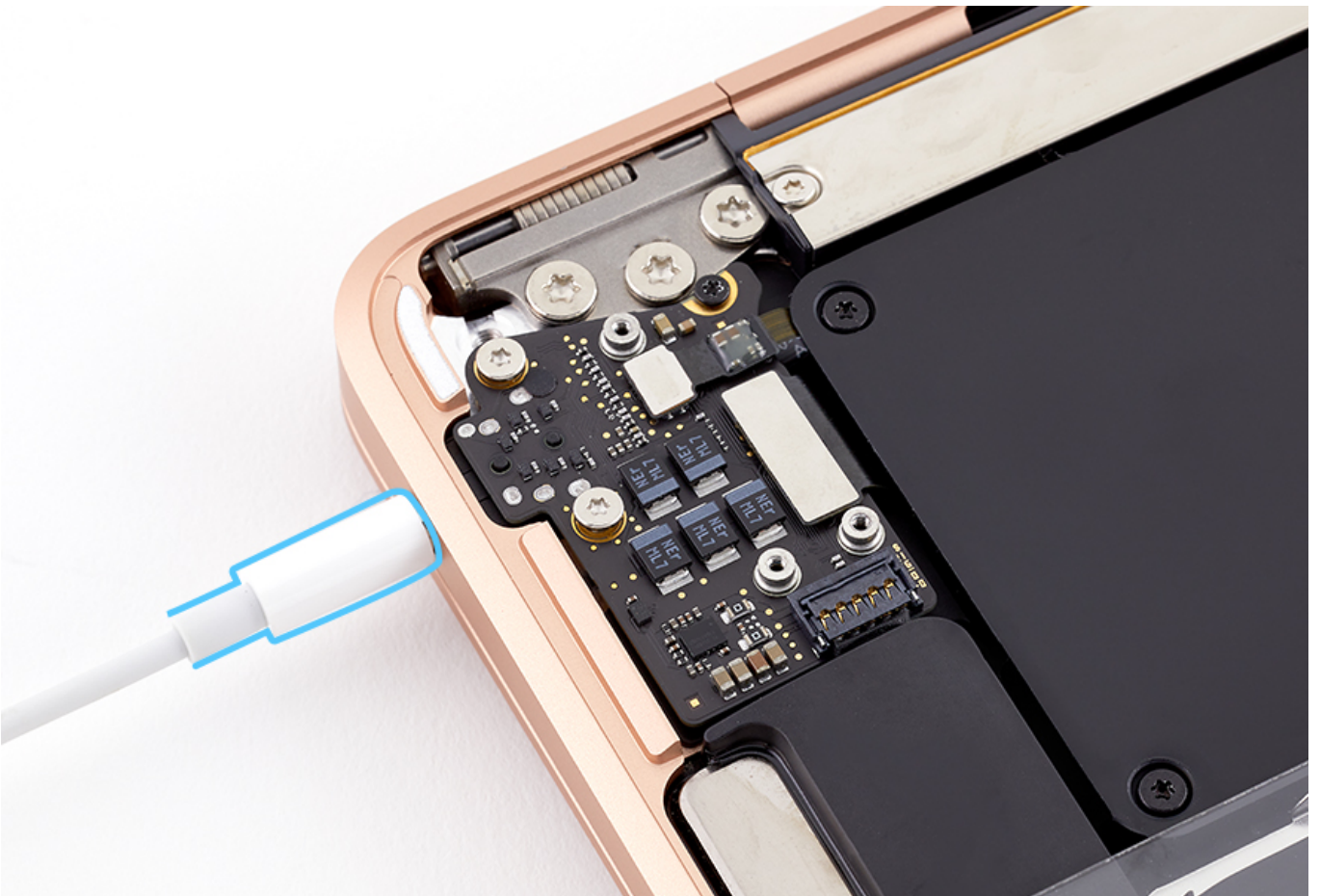
1. With the flex cables still gently taped out of the way, reinstall the audio board.



2. Reconnect the Touch ID flex connector, the audio board flex connector, and the speaker flex connector and loosely reinstall the three screws into the audio board.

3. Plug in a 3.5 mm jack to check alignment.





4. Tighten the audio board screws.
5. Reinstall the [bottom case](#).
6. **Important:** Run the appropriate [AST 2 diagnostic suites](#) (TP1909).



# MacBook Air (M1, 2020) Touch ID Board

## First Steps



### Warning:

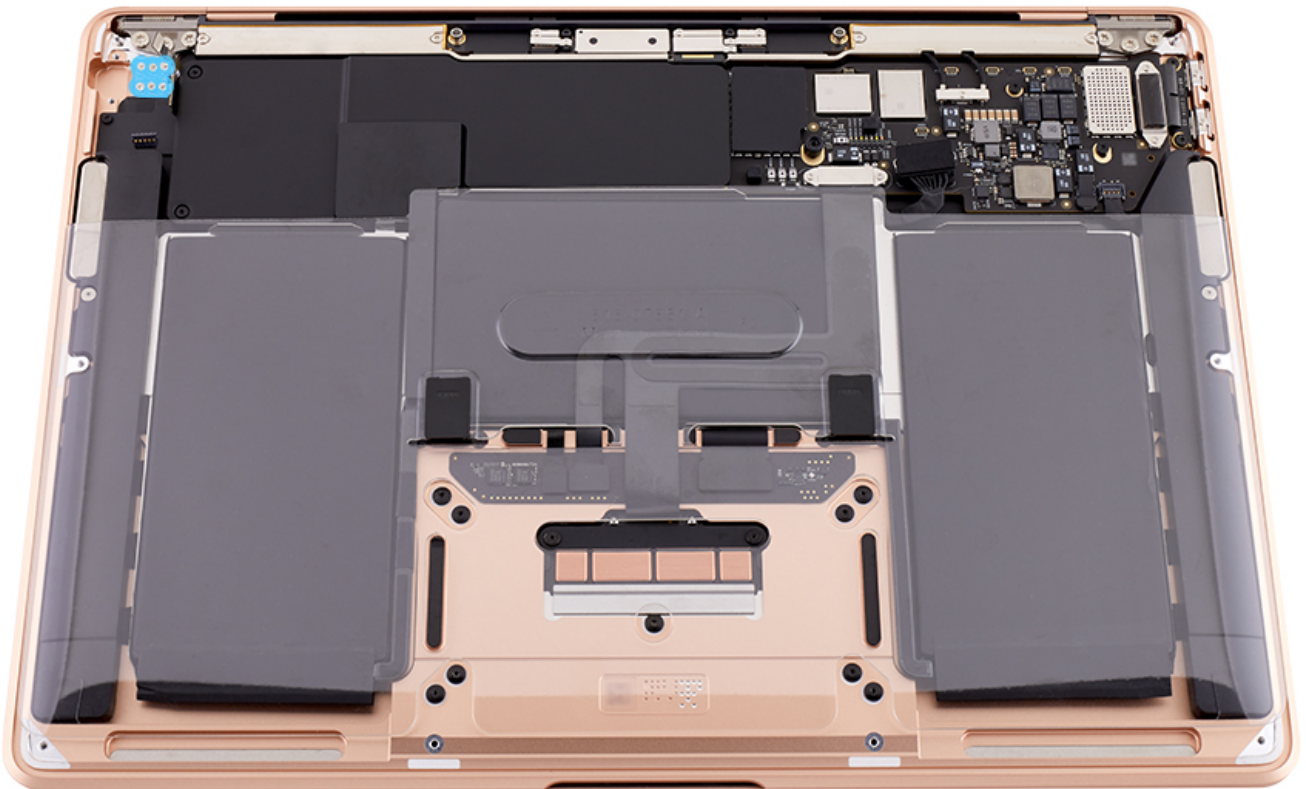
- To avoid damaging parts, attach the battery cover and disengage battery power immediately after removing the bottom case.
- Do not apply external power while the computer is under repair.

### Important:

- Only Apple-certified technicians should perform this procedure. For more information, refer to [OP1859: About Apple service certifications](#).
- Wear an ESD wrist strap and take precautions to avoid ESD.
- Completing the [System Configuration](#) (TP1901) suite is required for this procedure. Run the System Configuration suite to configure the replacement part with the computer.

### Remove:

- [Bottom Case](#)
- [Audio Board](#)



## Tools

1. Torx T3 screwdriver
2. Touch ID alignment kit including edge guide and Touch ID alignment tool (923-03032, included with replacement module)
3. Flat-nosed, ESD-safe tweezers
4. Kapton tape

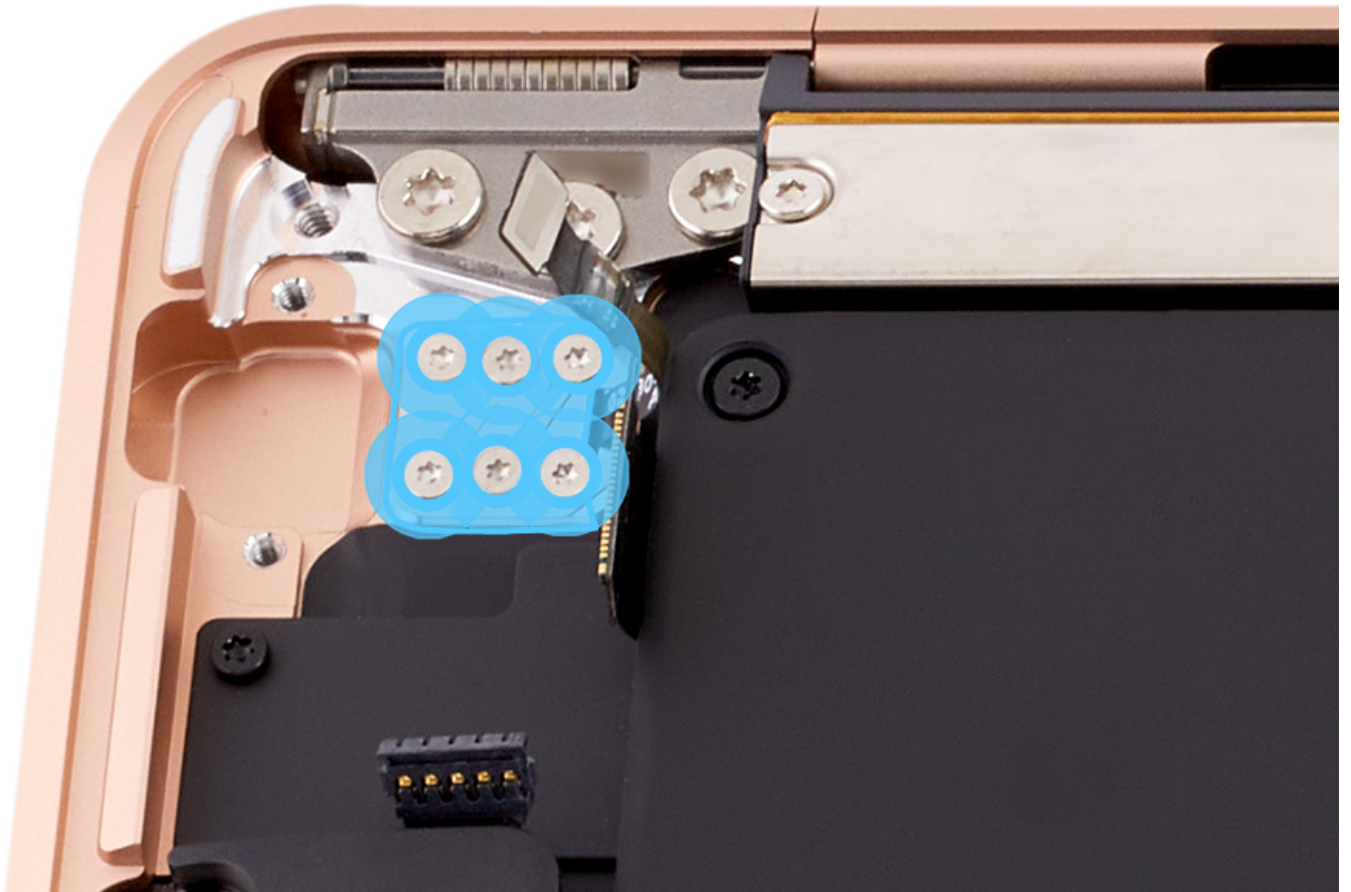


## Steps For Removal

**Important:** The Touch ID board is paired with the logic board, however the Touch ID board (661-15412) can be replaced on its own. The logic board does not also have to be replaced.

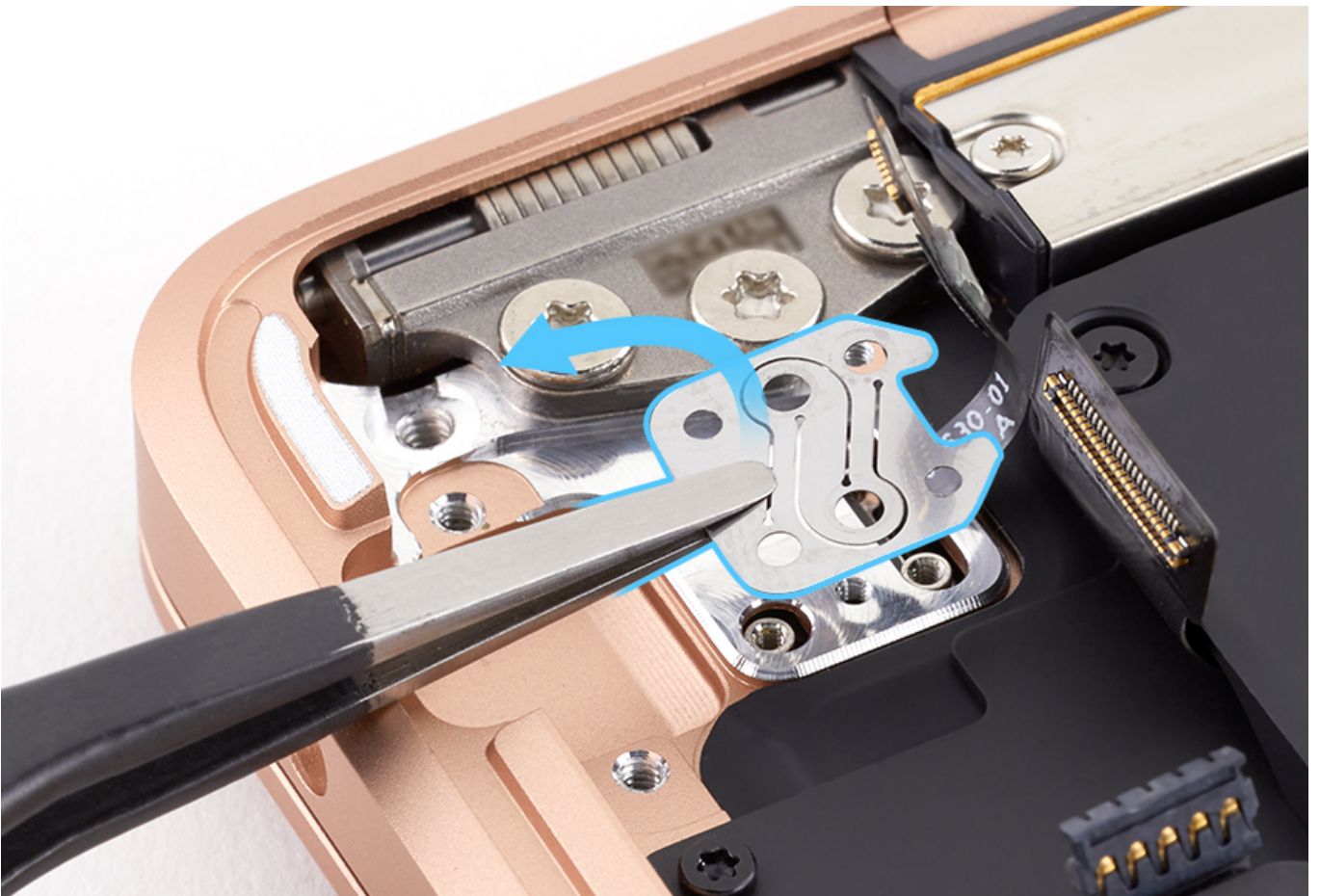
1. Remove the six T3 screws from the flexure.

- T3: 923-02888

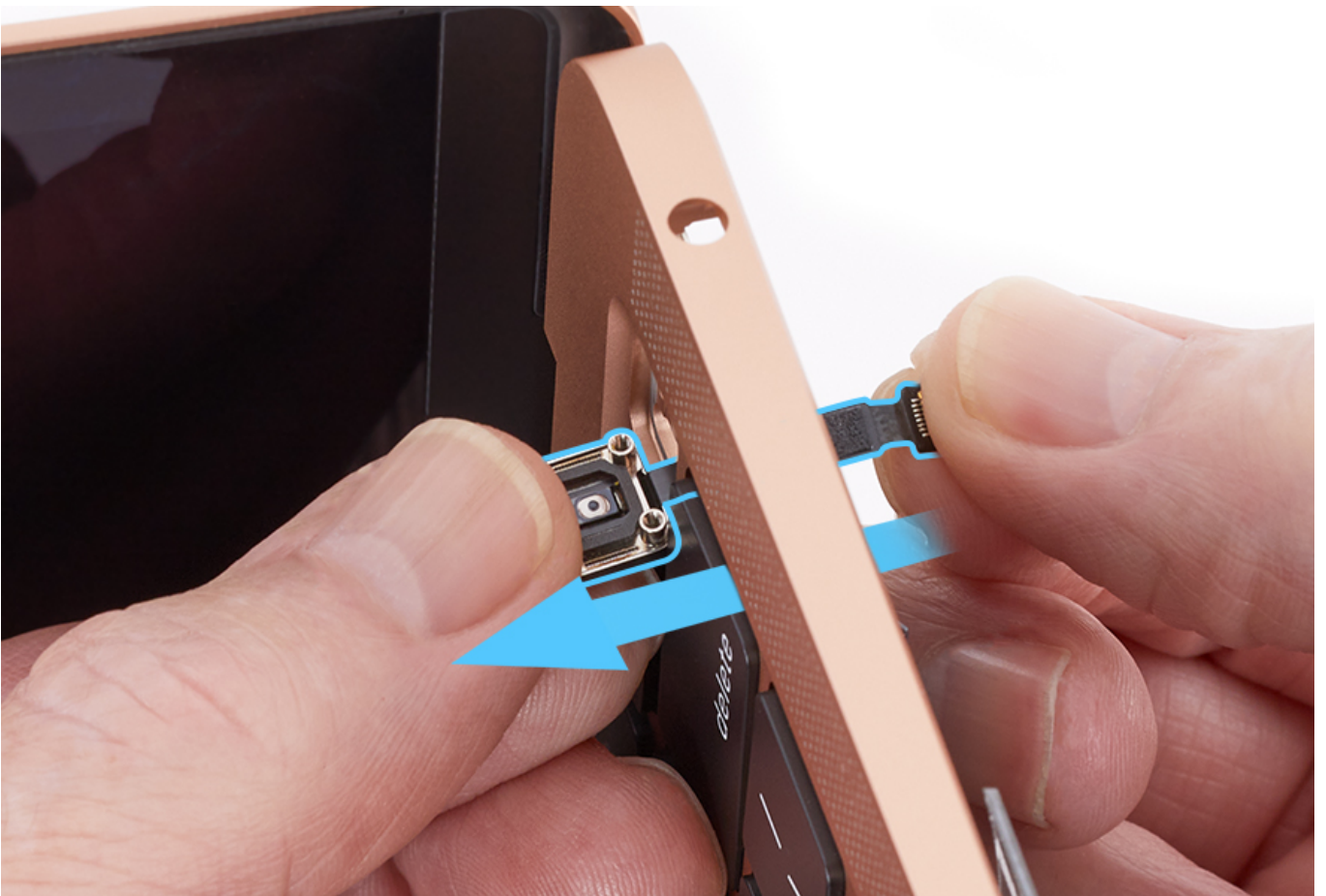


2. Use tweezers to remove the flexure. Set aside for reuse.





3. Open the display and stand the computer assembly on its side. With a hand on each side of the top case, support the Touch ID board as you thread the flex cable through the slot. Remove the Touch ID board from the keyboard side of the top case.



**Steps For Reassembly**

**Note:** If you are installing a replacement Touch ID board, remove the protective film from the glass surface.

1. Place the computer upright with the display fully open. Set two Y-shaped alignment tools in the top case opening and situate the tabs in the corner edge. Secure the tools with Kapton tape.

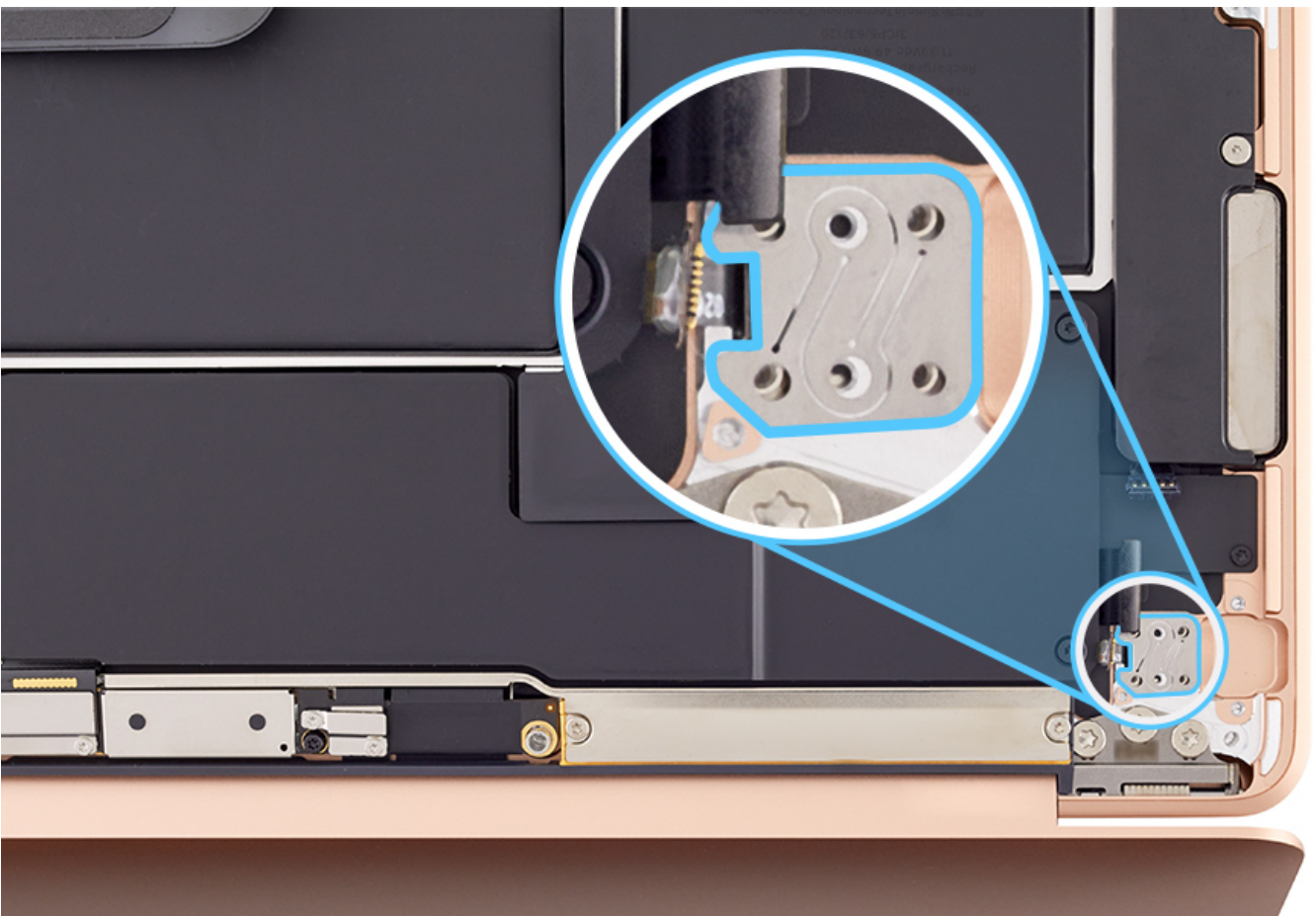


2. Place the computer on its side, thread the flex cable through the slot in the top case. Press the Touch ID button into the square opening.





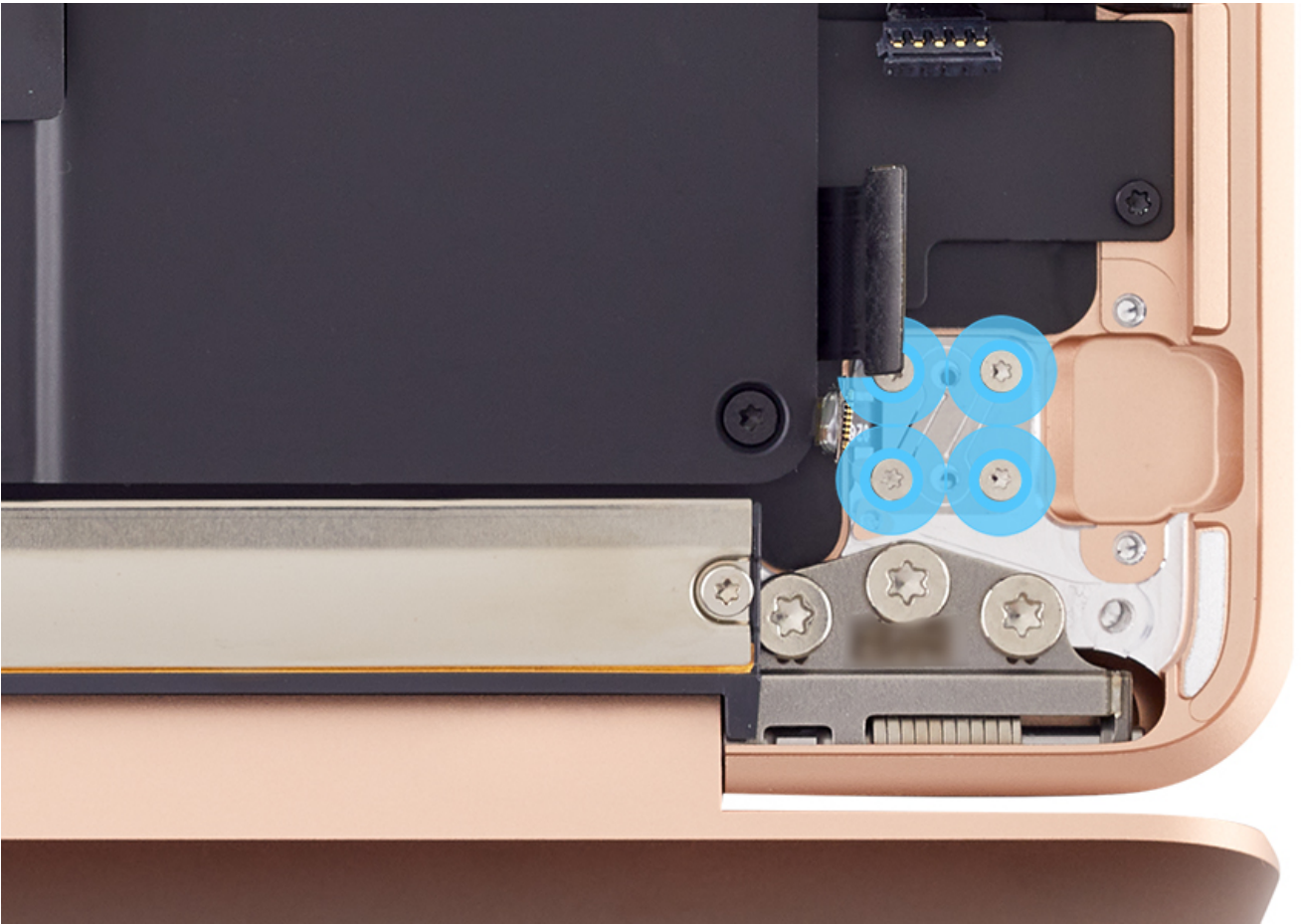
3. Place the computer on the edge of the workbench with the display hanging down. Using tweezers, reinstall the flexure so that the keyed side fits the Touch ID cable. Be sure it is installed right side up or the button may not function properly.



4. Loosely install the four outside T3 screws first.

- T3: 923-02888

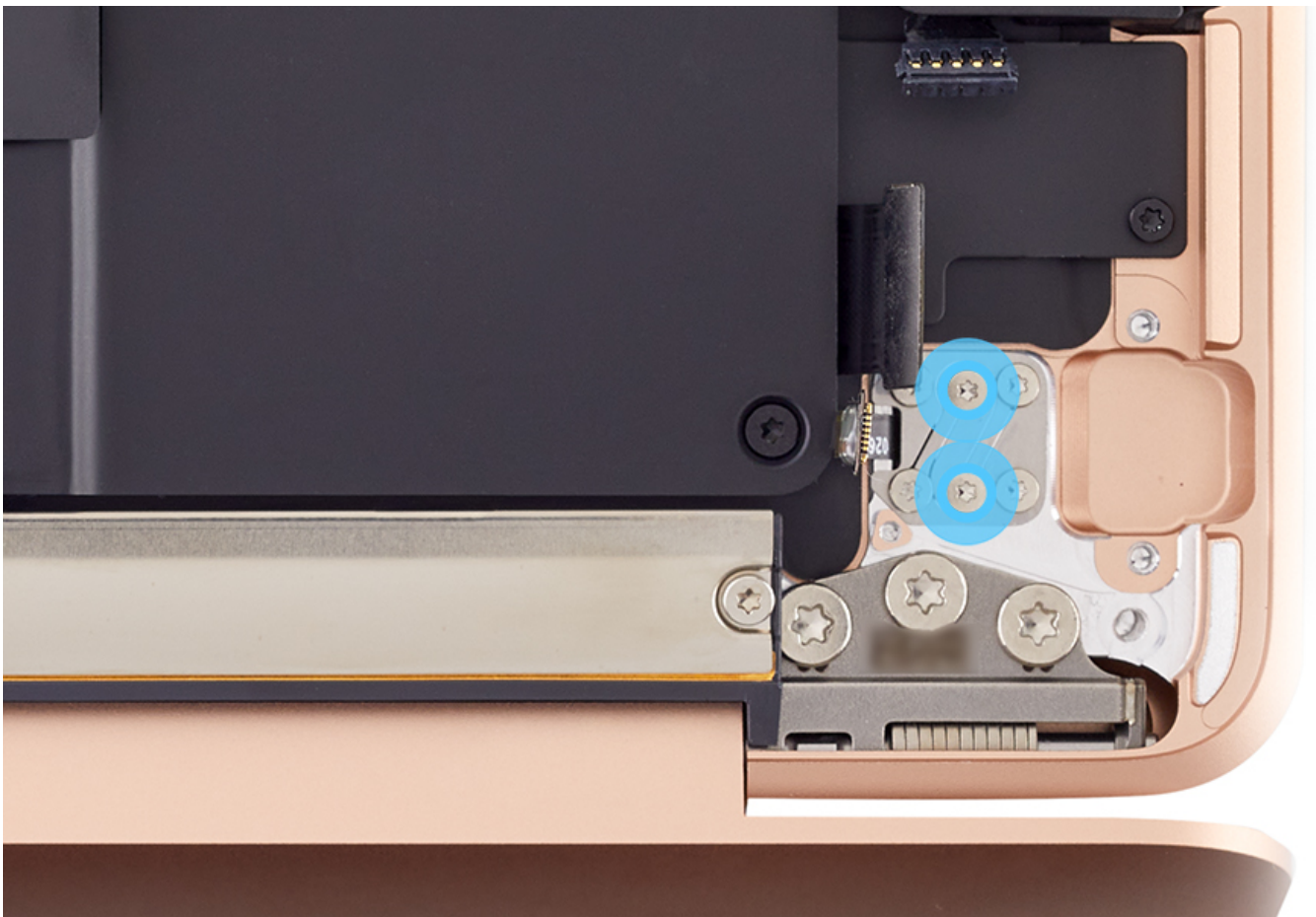




5. Loosely install the middle T3 screws.

- T3: 923-02888





6. Starting from the corner screws, tighten all six screws.

7. Place the computer flat on the ESD mat, be careful not to bend the Touch ID flex cable. **Warning:** Be sure the battery cover is attached.

8. Remove the tape and alignment tools and look at the Touch ID button to verify that all the sides are spaced equally. If not, loosen the screws and start the alignment process again.



9. Press the Touch ID button to verify that it makes a clicking noise. If the button does not move at all or moves but does not click, refer to [RP1352: Touch ID Shim](#) for details.

10. Reinstall the [audio board](#).

11. Reinstall the [bottom case](#).

**Important:**

12. Run the [System Configuration](#) (TP1901) suite to configure the replacement part with the computer. Completing the System Configuration suite is required for the display, logic board, and Touch ID board procedures.

13. Run the appropriate [AST 2 diagnostic suites](#) (TP1909).



# MacBook Air (Retina, 13-inch, 2018-2020), MacBook Air (M1, 2020), MacBook Pro (13-inch, 2019 and 2020, Two Thunderbolt 3 Ports), MacBook Pro (13-inch, 2016-2020, Four Thunderbolt 3 Ports), and MacBook Pro (13-inch, M1, 2020) Touch ID Shim

## First Steps



### Warning:

- To avoid damaging parts, you must install the battery cover and either disconnect the battery or disengage battery power to the logic board.
- Don't connect the computer to any external power source during repair.

### Important:

- Only [Apple-certified technicians](#) (OP1859) should perform this procedure.
- Wear an ESD wrist strap and [take precautions to avoid ESD](#) (OP100).
- The Touch ID alignment kit and replacement Touch ID shims are included in part boxes when Touch ID reinstallation or replacement is necessary. Learn how and when to use these parts in Touch ID reassembly steps.

**Note:** The images shown are of MacBook Pro (13-inch, 2016, Four Thunderbolt 3 Ports), but the process is the same for MacBook Air (Retina, 13-inch, 2018, 2019, and 2020), MacBook Air (M1, 2020), MacBook Pro (13-inch, 2019 and 2020, Two Thunderbolt 3 Ports), MacBook Pro (13-inch, M1, 2020), and MacBook Pro (13-inch, 2017, 2018, 2019, 2020, Four Thunderbolt 3 Ports).



## Tools

- Torx T3 screwdriver (magnetized)
- ESD-safe tweezers

- Shim kit, package of 3 (923-01519), not shown



## Steps For Removal

**Note:** The Touch ID shim is a tiny, circular part. Ensure that your work surface is completely clean. A clean surface allows easy location of the shim if it falls on the ESD mat during repair.

1. Determine the required Touch ID shim size:

- If the button feels too loose or doesn't click, a larger shim is required.
- If the button feels too stiff or doesn't move, a smaller shim is required.



2. Spread the tips of the ESD-safe tweezers, and use one tip to push the shim out.





3. Retrieve the loose shim on the keyboard side of the top case. The shim has a small amount of adhesive and may stick to the top case. The shim is black on the adhesive side and silver on the opposite side.



### Steps For Reassembly

1. Replace the Touch ID shim with one of the shims from the kit (923-01519). Shims are marked and organized by size.
  - Use ESD-safe tweezers to remove the appropriate shim from the backing.
  - Hold less than half of the shim with the ESD-safe tweezer for easier installation.
2. Set the computer flat on the ESD mat.

**Important:** For MacBook Pro models, ensure that the battery cover is in position and the I/O board(s) are flat.

3. Align the shim in the recessed circle on the top case.



4. Gently press the shim to activate the adhesive.



5. Reinstall the Touch ID board for the model you're repairing:

- [MacBook Air \(M1, 2020\)](#) (RP1685)
- [MacBook Air \(Retina, 13-inch, 2020\)](#) (RP1612)
- [MacBook Air \(Retina, 13-inch, 2018 and 2019\)](#) (RP1463)



- [MacBook Pro \(13-inch, 2020, Two Thunderbolt 3 Ports\)](#) (RP1648)
- [MacBook Pro \(13-inch, 2019, Two Thunderbolt 3 Ports\)](#) (RP1529)
- [MacBook Pro \(13-inch, M1, 2020\)](#) (RP1704)
- [MacBook Pro \(13-inch, 2020, Four Thunderbolt 3 Ports\)](#) (RP1626)
- [MacBook Pro \(13-inch, 2016, 2017, 2018, 2019, Four Thunderbolt 3 Ports\)](#) (RP1346)

**Note:** Confirm that Touch ID and the power button function correctly with the new shim installed.

# MacBook Air (M1, 2020) Logic Board

## First Steps



### Warning:

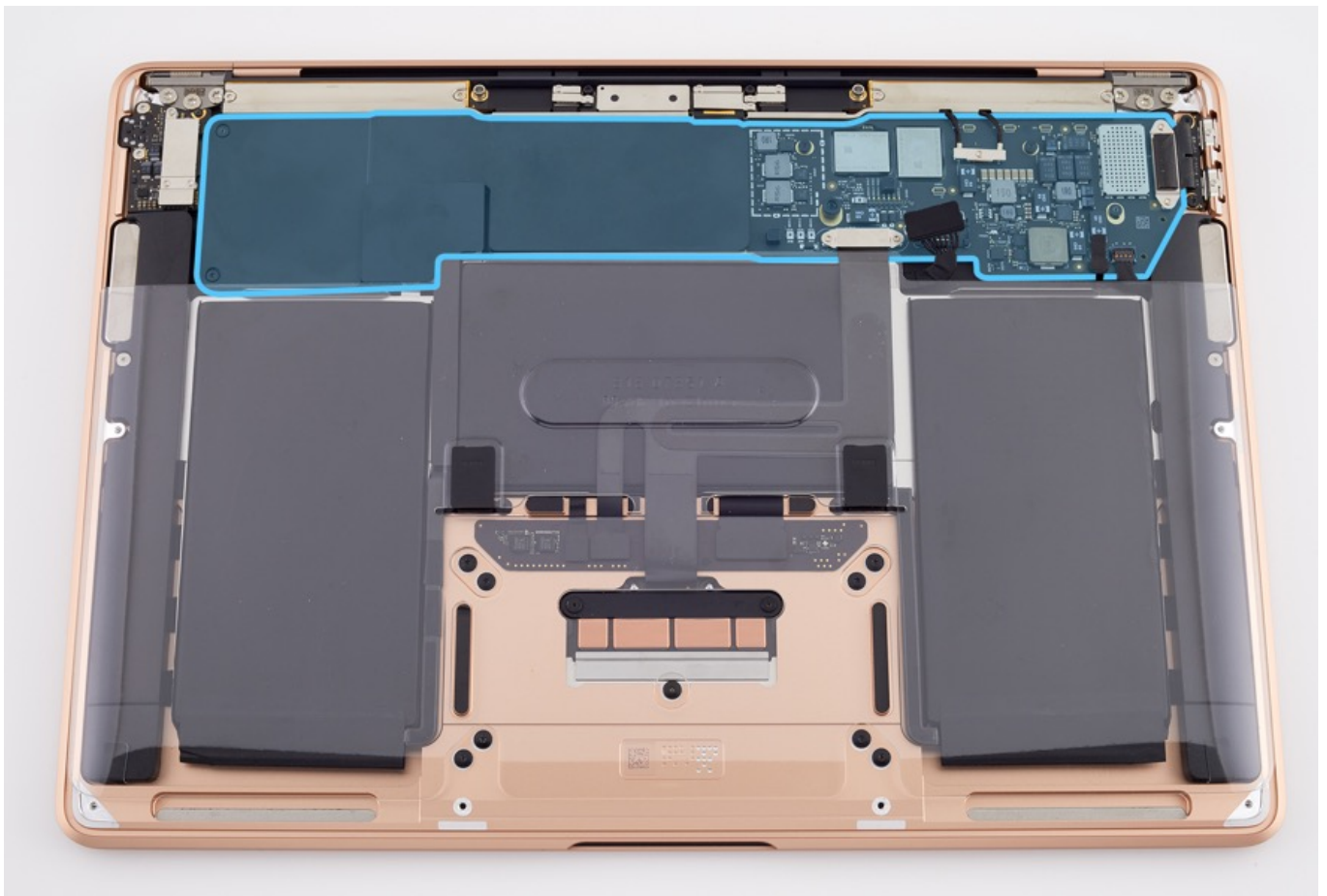
- To avoid damaging parts, attach the battery cover and disengage battery power immediately after removing the bottom case.
- After disconnecting the battery, allow it to discharge for one minute before proceeding with this repair.
- Do not apply external power while the computer is under repair.

### Important:

- Only Apple-certified technicians should perform this procedure. For more information, refer to [OP1859: About Apple service certifications](#).
- Wear an ESD wrist strap and take precautions to avoid ESD.
- If the logic board is replaced, the [Touch ID board](#) (RP1685) must also be replaced.
- The heat spreader is not a separate part. Do not attempt to remove the heat spreader from the logic board.
- There are two types of heat spreader. The 7-Core GPU has a thinner heat spreader with no graphite, while the 8-Core GPU has an extra layer of graphite foam.
- Completing the [System Configuration](#) (TP1901) suite is required for this procedure. Run the System Configuration suite to configure the replacement part with the computer.
- [Apple Configurator 2](#) is required after System Configuration to install the latest macOS and firmware.

### Remove:

- [Bottom Case](#)



## Tools



1. Torx T3 screwdriver
2. Torx T5 screwdriver
3. Antenna tool (923-01322)
4. Black stick

## Steps For Removal

1. Remove the T3 screws from the following five cowlings. Remove the cowlings and set aside for reuse.

1. I/O board cowling
2. IPD flex cable cowling
3. Audio board cable cowling
4. eDP flex cable cowling
5. Wireless antennas cowling

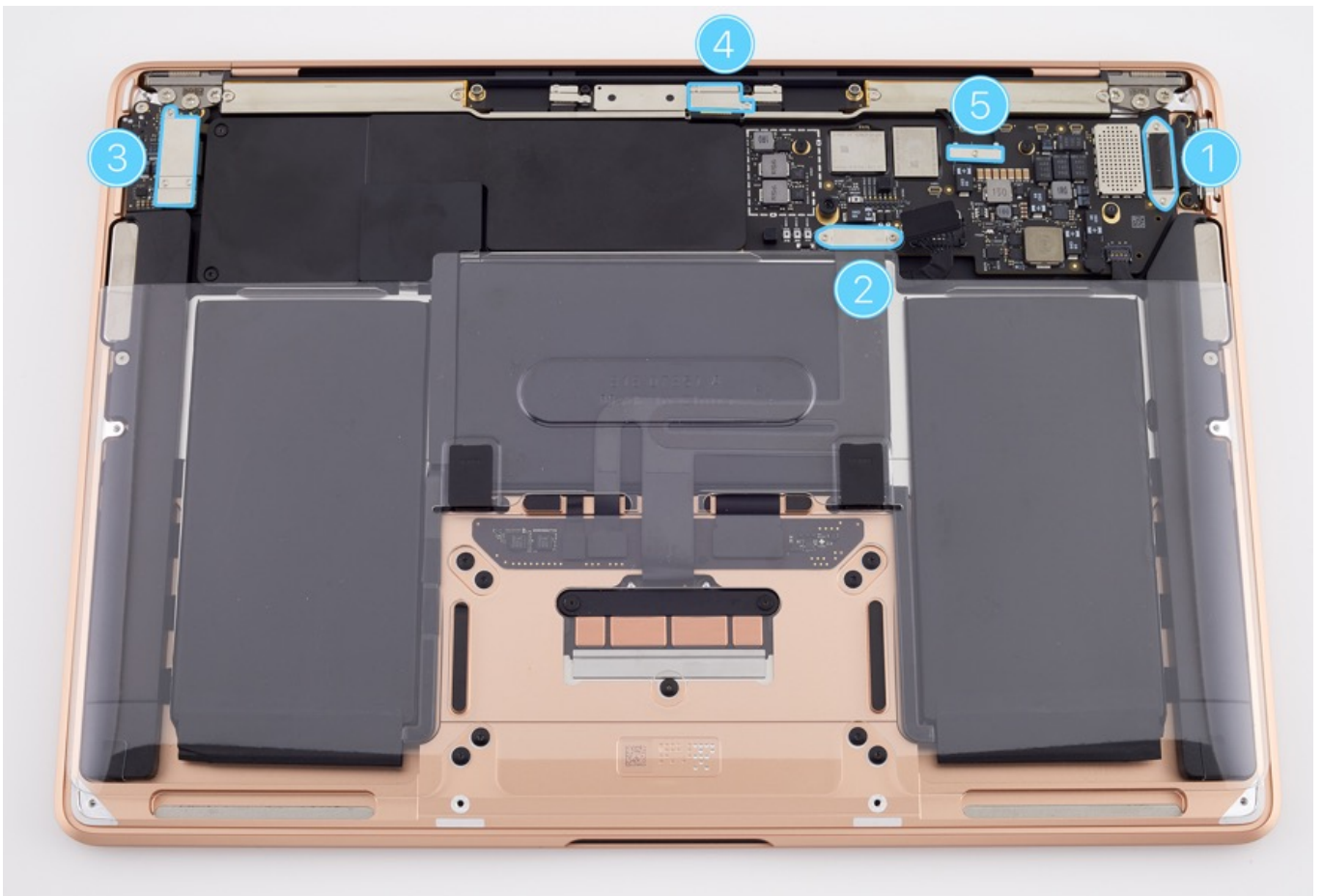
- T3: 923-04003



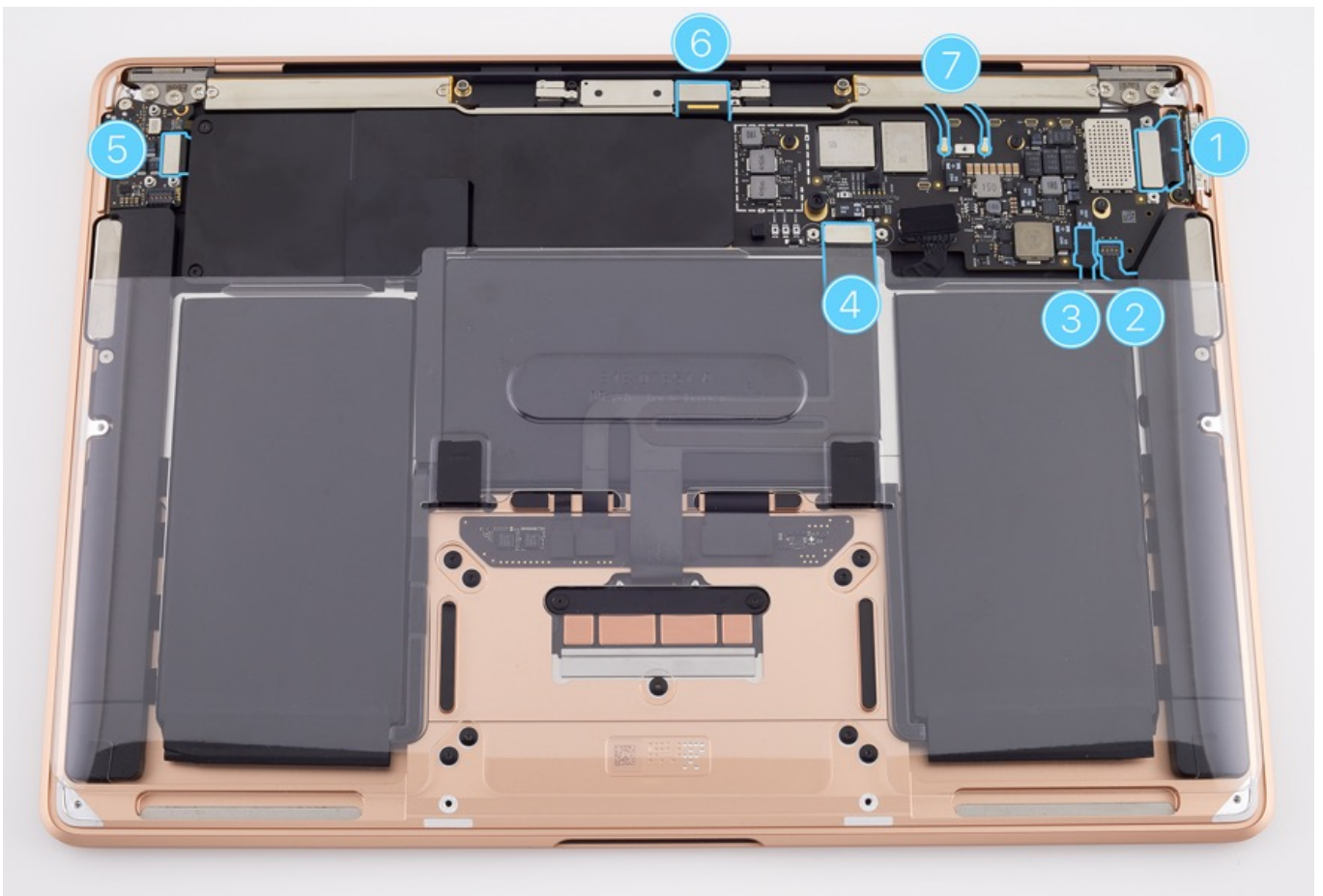
- T3: 923-04004 (number 4)







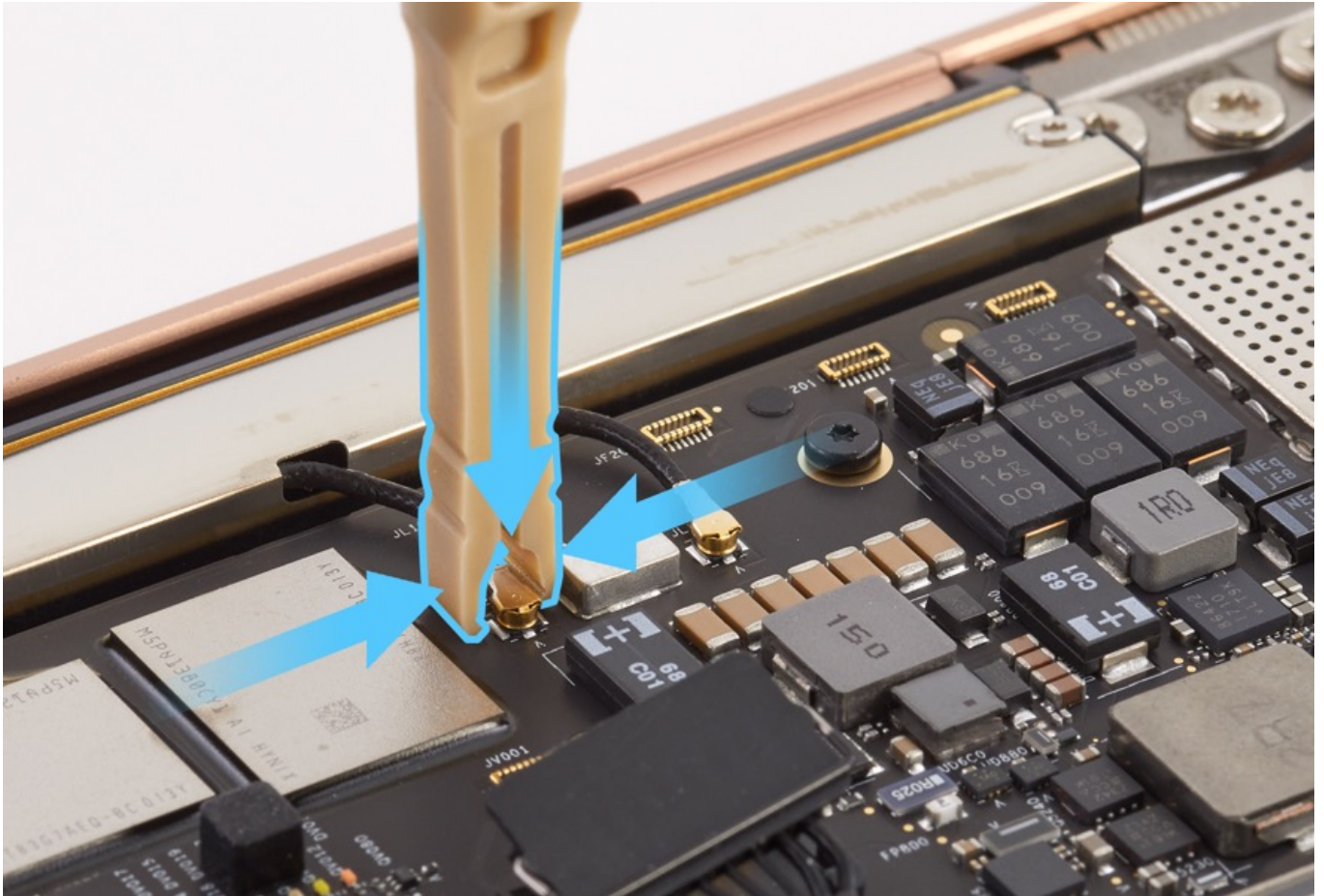
2. Disconnect flex connectors from the logic board.



1. I/O board flex connector
2. Left speaker flex connector
3. Mic flex connector
4. IPD flex connector
5. Audio board flex connector

6. eDP flex connector
7. Antenna connectors

**Note:** Use the antenna tool to disconnect the two wireless antennas from the logic board.



4. Remove the six T5 screws from the logic board.

1 = T5: 923-05305



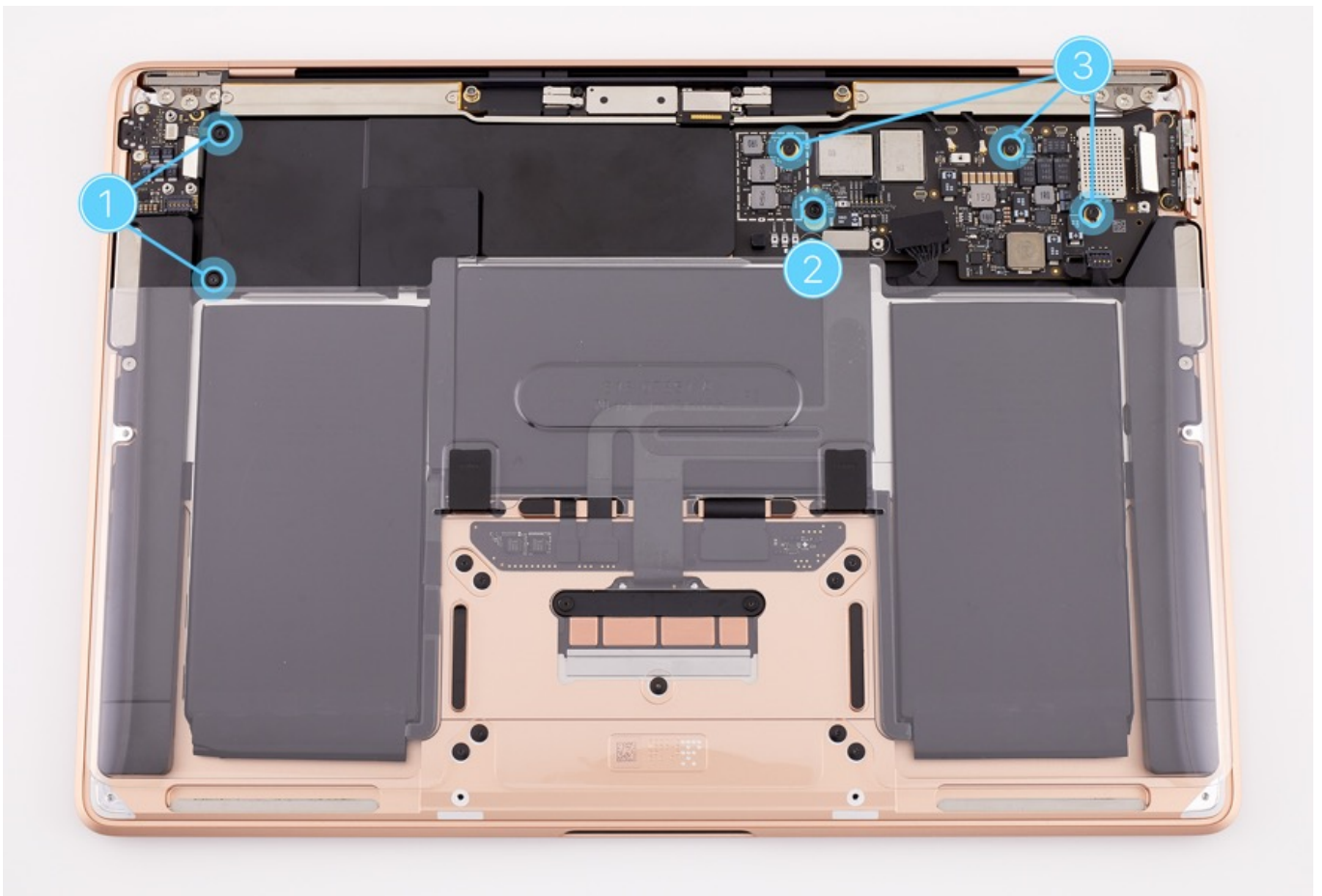
2 = T5: 923-04007



3 = T5: 923-03999

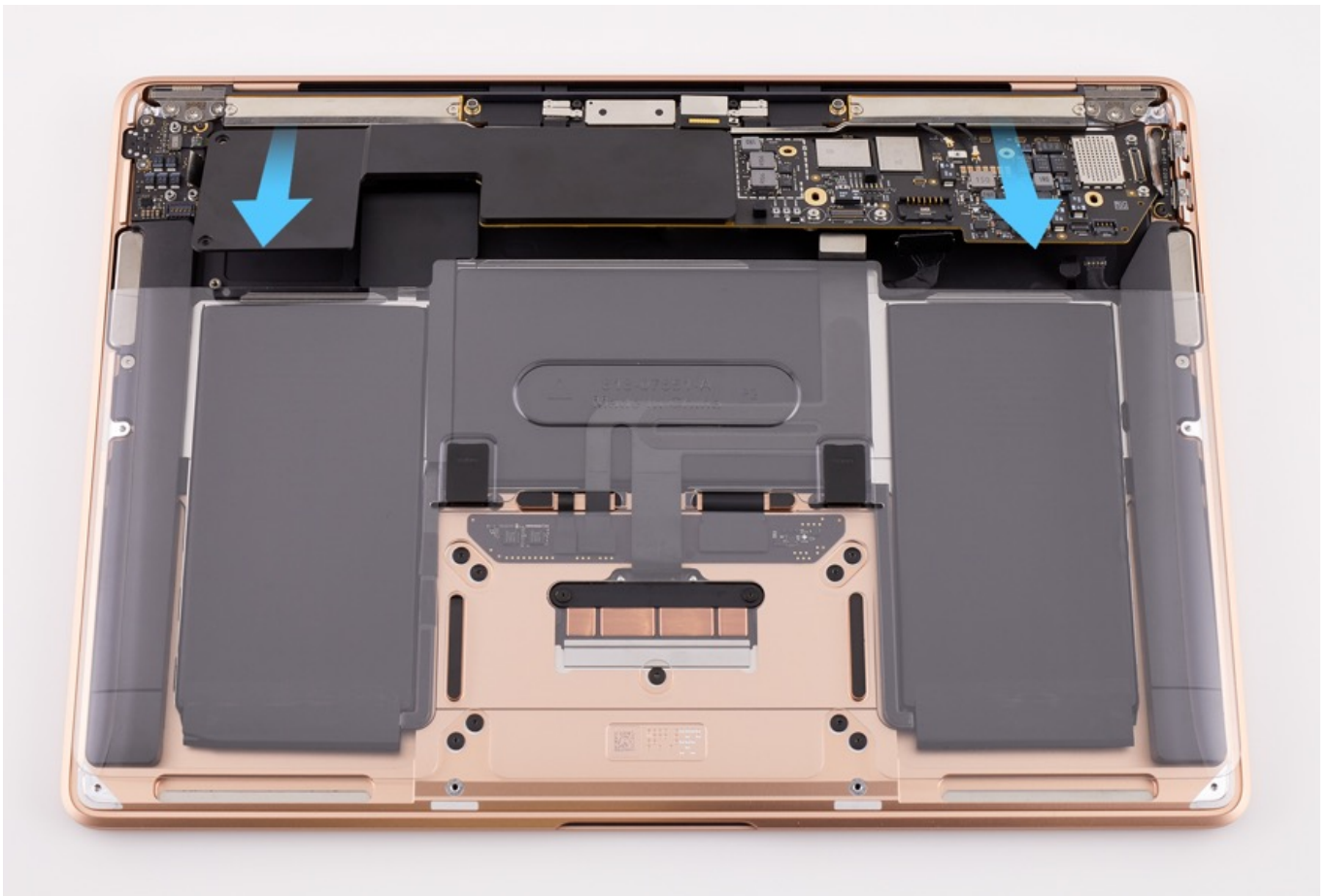






**Important:** If you are installing a replacement logic board, remove and transfer the [eDP flex cable](#) (RP1687) and the [audio board flex cable](#) (RP1683) to the new logic board.

5. Tilt up the logic board and slide the board out of the top case.



**Caution:** Hold the logic board by the edges and do not touch the gold pins.

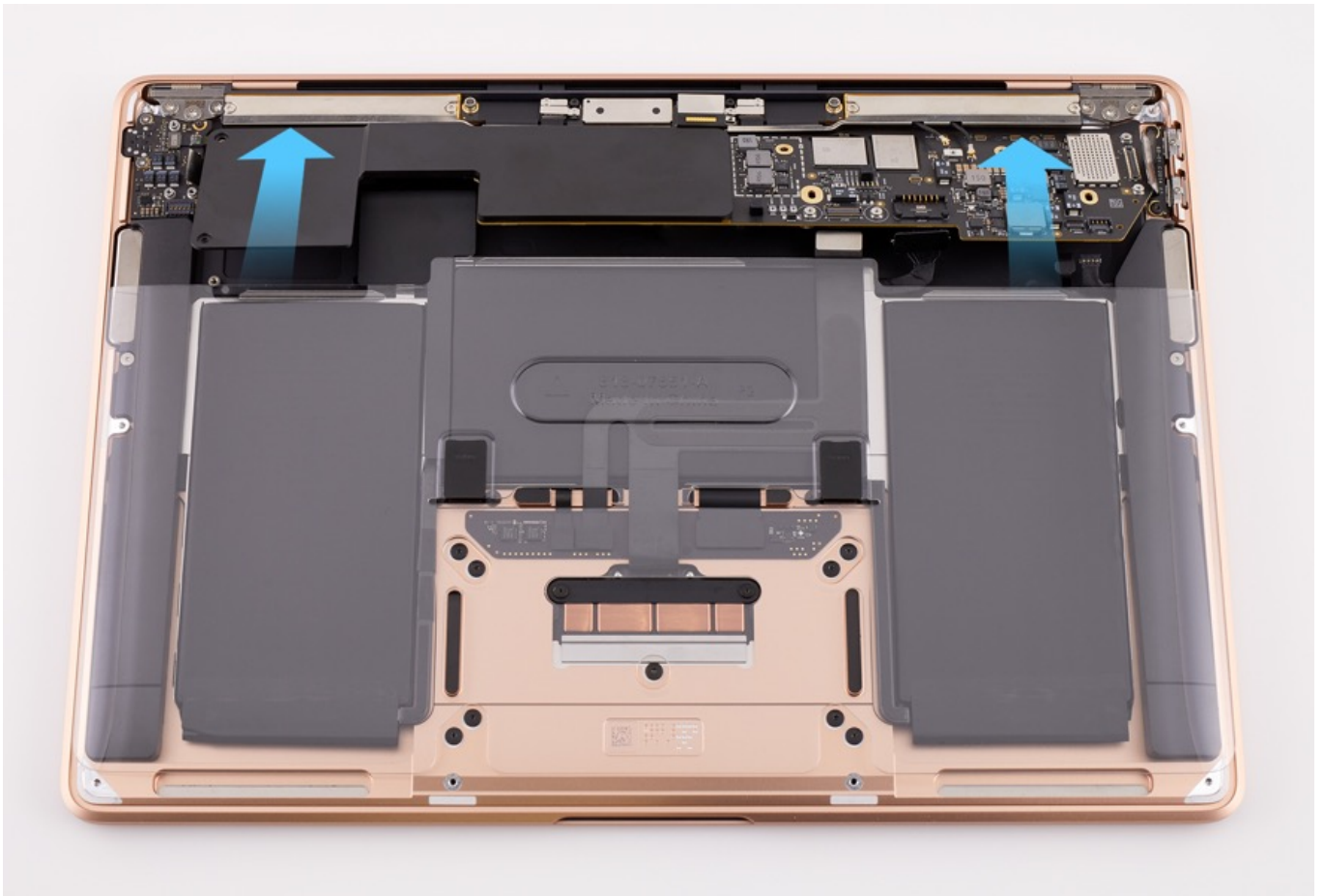
## Steps For Reassembly



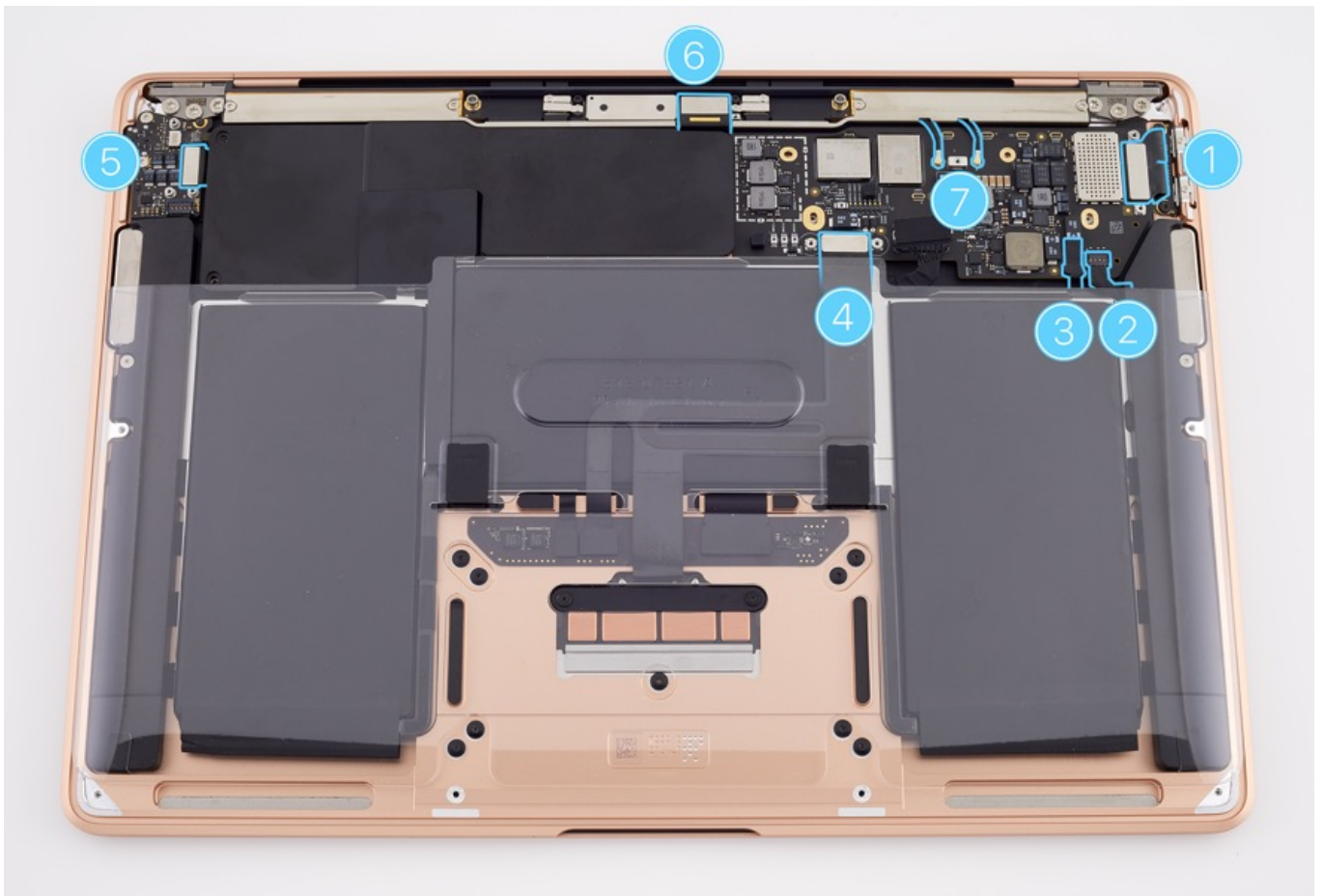
### Caution:

- Be sure no cables are caught under the logic board before attaching the antennas and screwing down the logic board. Bending the cables under the board can cause damage to the cables.
- Hold the logic board by the edges and do not touch the gold pins.
- If installing a replacement logic board, be sure to transfer the [eDP flex cable](#) (RP1687) and the [audio board flex cable](#) (RP1683) to the new board.

1. Place the logic board back into the bottom case.



2. Reconnect the flex connectors, except the battery connector.



1. I/O board flex connector
2. Left speaker flex connector
3. Mic flex connector
4. IPD flex connector
5. Audio board flex connector
6. eDP flex connector
7. Antenna connectors

**Note:** When reconnecting the antennas, use tweezers to align the antenna head with the connector on the logic board (1). Then use the flip side of the antenna removal tool to make the connection (2).

3. Reinstall the logic board screws.

1 = T5: 923-05305



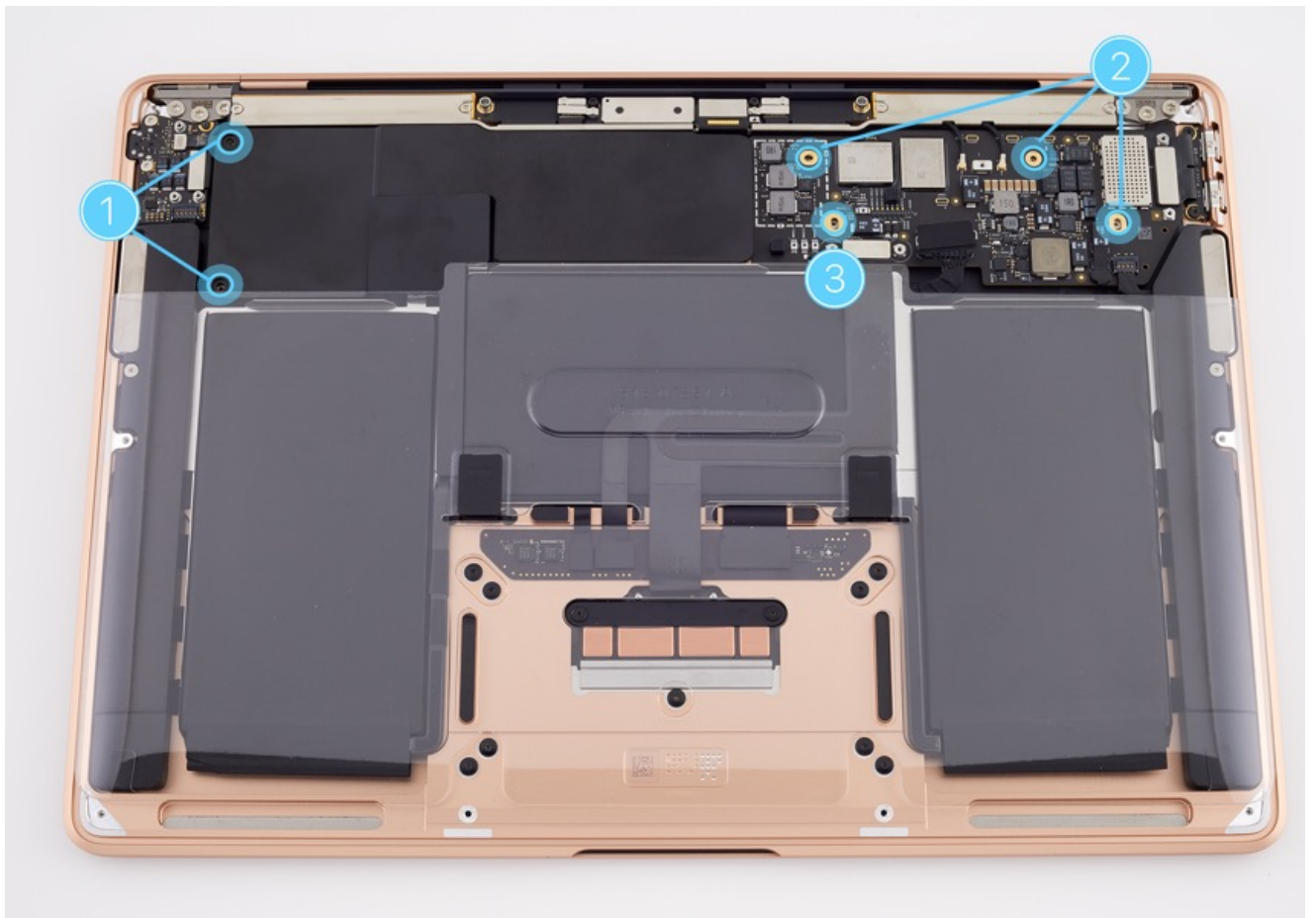
2 = T5: 923-04007



3 = T5: 923-03999







4. Reinstall the five cowlings and the T3 screws for each.

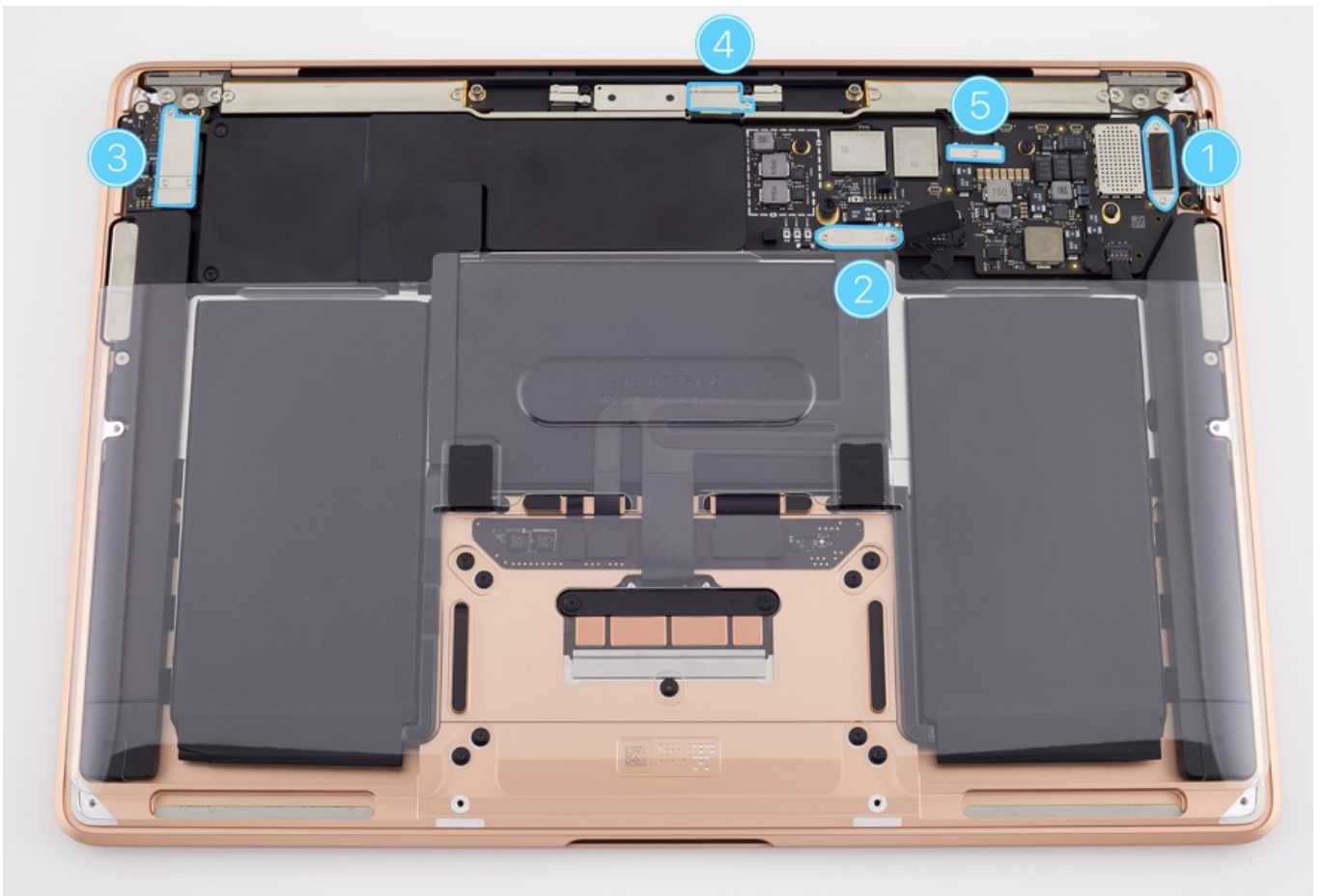
1. I/O board cowling
2. IPD flex cable cowling
3. Audio board cowling
4. eDP flex cable cowling
5. Wireless antennas cowling

- T3: 923-04003



- T3: 923-04004 (number 4)





**Important:**

- If the logic board is replaced, the [Touch ID board](#) (RP1685) must also be replaced.
- If you are installing a replacement logic board, remove and transfer the [eDP flex cable](#) (RP1687) and the [audio board flex cable](#) (RP1683) to the new logic board.

5. Reinstall the [bottom case](#).

**Important:**

6. Run the [System Configuration](#) (TP1901) suite to configure the replacement part with the computer. Completing the System Configuration suite is required for the display, logic board, and Touch ID board procedures.
7. Use [Apple Configurator 2](#) (TP1954) to install the latest macOS and firmware.
8. Run the appropriate [AST 2 diagnostic suites](#) (TP1909).

# MacBook Air (M1, 2020) Embedded DisplayPort (eDP) Flex Cable

## First Steps



### Warning:

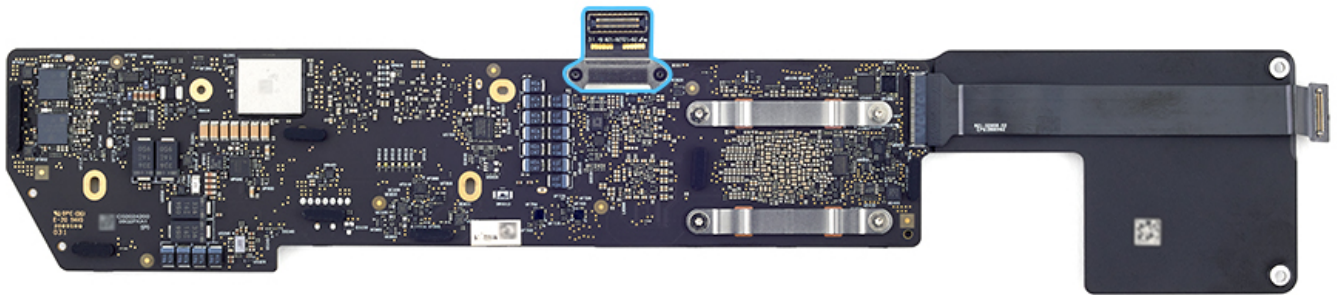
- To avoid damaging parts, attach the battery cover and disengage battery power immediately after removing the bottom case.
- Do not apply external power while the computer is under repair.

### Important:

- Only Apple-certified technicians should perform this procedure. For more information, refer to [OP1859: About Apple service certifications](#).
- Wear an ESD wrist strap and take precautions to avoid ESD.

### Remove:

- [Bottom Case](#)
- [Logic Board](#)



## Tools

1. Torx T3 screwdriver (magnetized)
2. Black stick

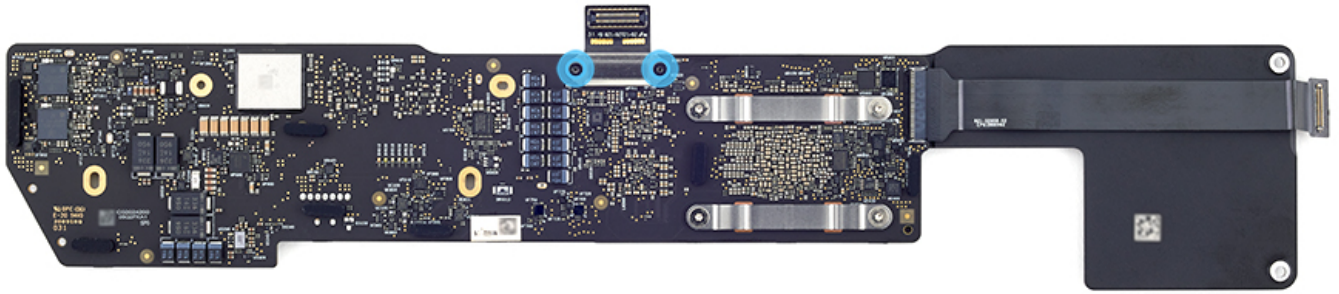


## Steps For Removal

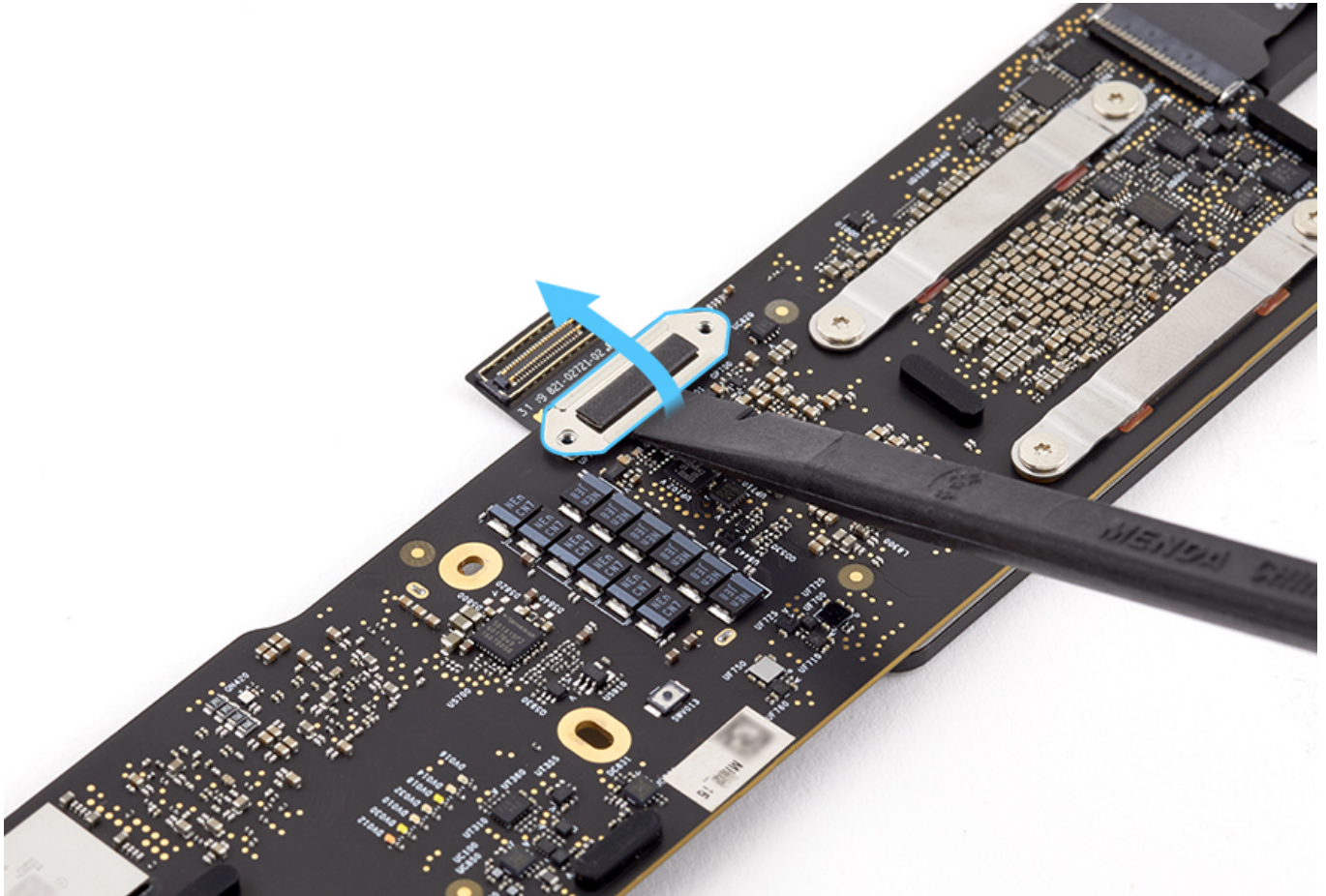
1. Turn the logic board over.
2. Remove two T3 screws from the eDP flex connector.

- T3: 923-02890





3. Use a black stick to disconnect the eDP flex cable from the logic board.



### Steps For Reassembly

1. Reconnect the eDP flex cable to the logic board.
2. Reinstall the two T3 screws.
3. Reinstall the [logic board](#).
4. Reinstall the [bottom case](#).
5. Run the appropriate [AST 2 diagnostic suites](#) (TP1909).



# MacBook Air (M1, 2020) Audio Board Flex Cable

## First Steps



### Warning:

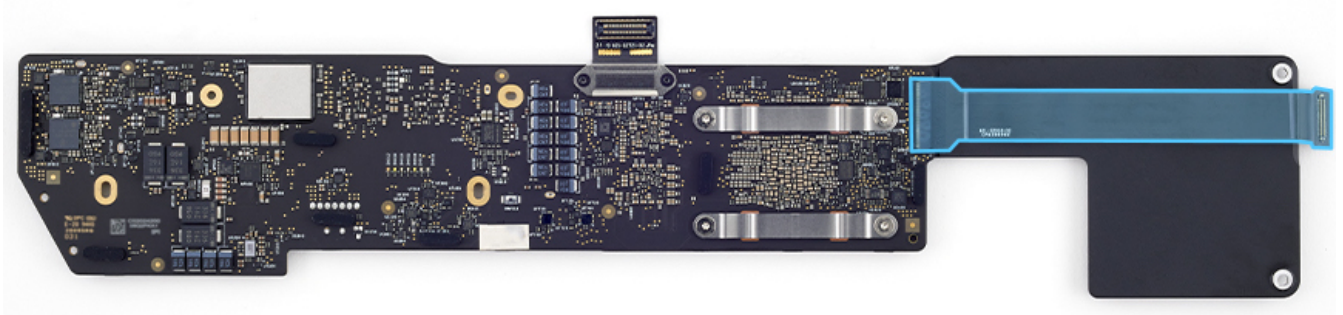
- To avoid damaging parts, attach the battery cover and disengage battery power immediately after removing the bottom case.
- Do not apply external power while the computer is under repair.

### Important:

- Only Apple-certified technicians should perform this procedure. For more information, refer to [OP1859: About Apple service certifications](#).
- Wear an ESD wrist strap and take precautions to avoid ESD.

### Remove:

- [Bottom Case](#)
- [Logic Board](#)



## Tools

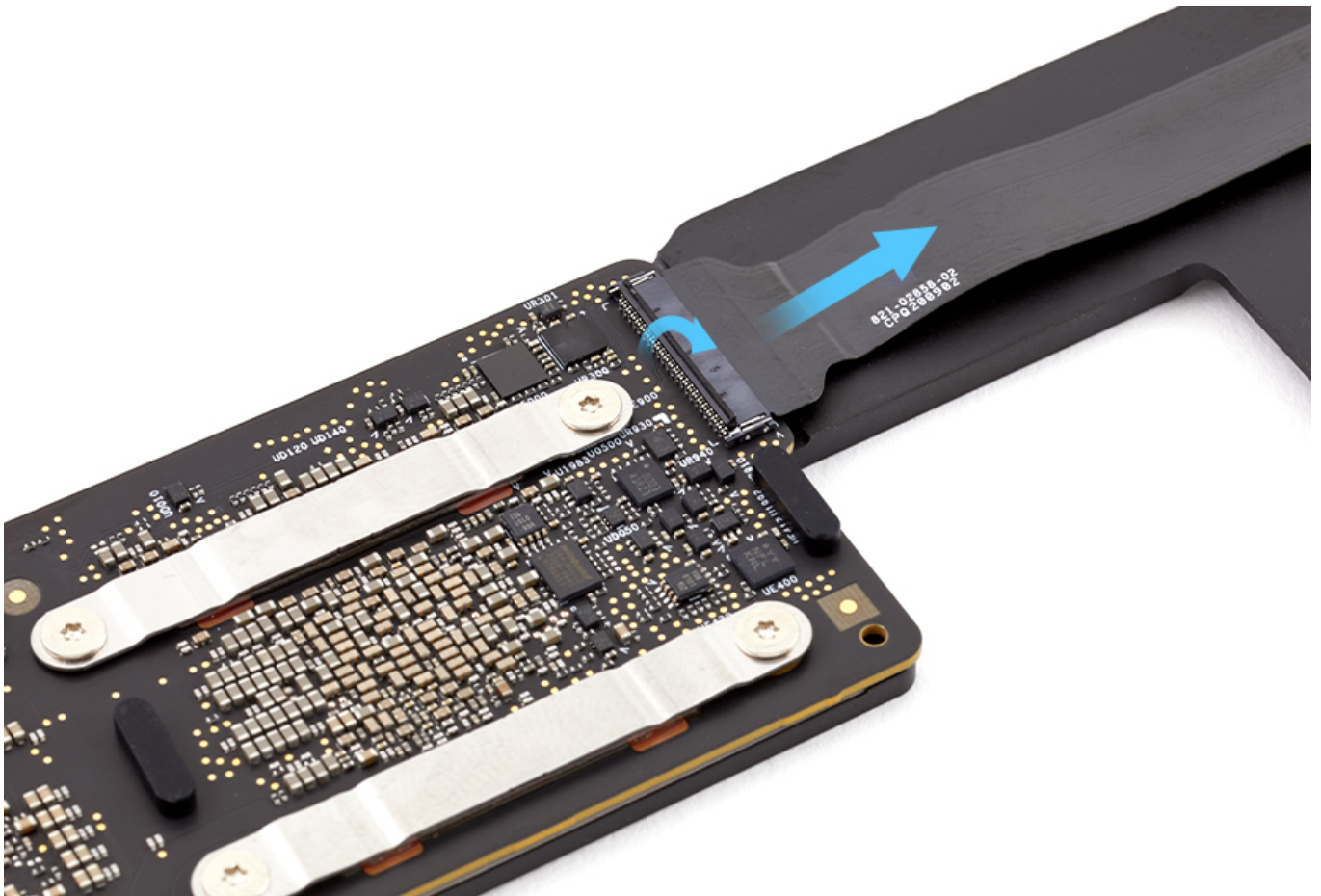
1. Black stick



## Steps For Removal

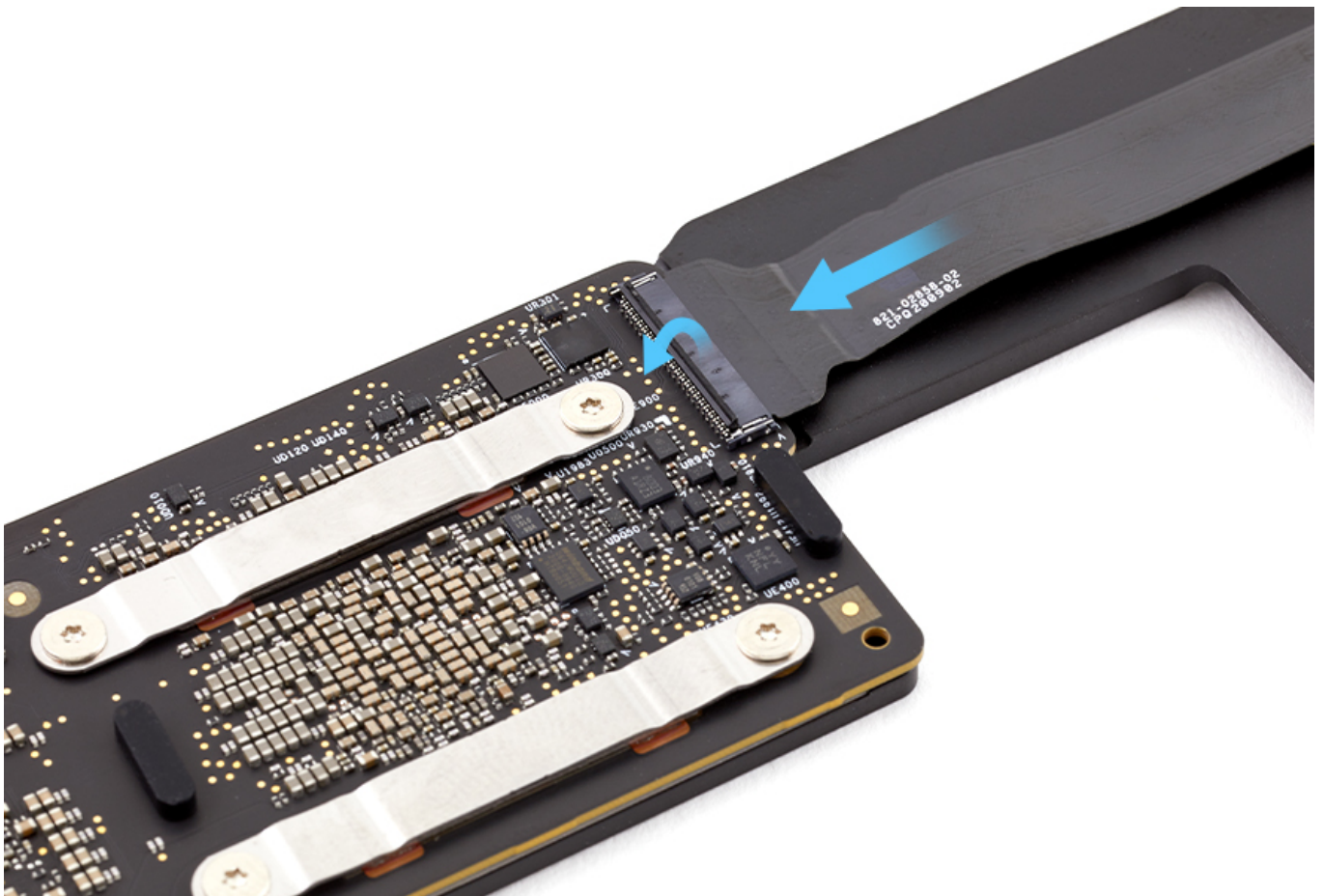
1. Lift the locking lever and remove the flex cable.





### Steps For Reassembly

1. Install the flex cable and close the locking lever.



2. Reinstall the [logic board](#).

3. Reinstall the [bottom case](#).
4. **Important:** Run the appropriate [AST 2 diagnostic suites](#) (TP1909).

# MacBook Air (M1, 2020) Vent/Antenna Module

## First Steps



### Warning:

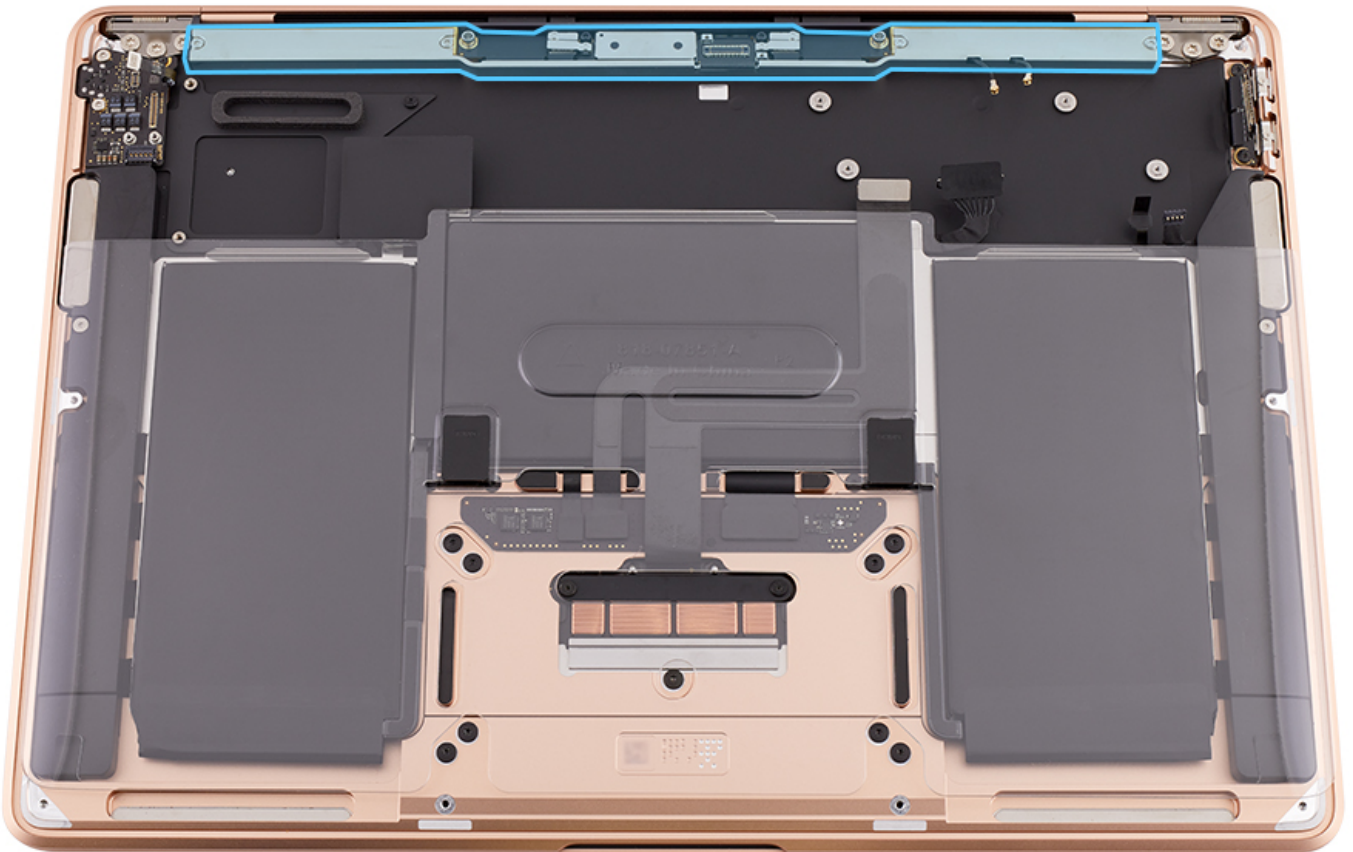
- To avoid damaging parts, attach the battery cover and disengage battery power immediately after removing the bottom case.
- Do not apply external power while the computer is under repair.

### Important:

- Only Apple-certified technicians should perform this procedure. For more information, refer to [OP1859: About Apple service certifications](#).
- Wear an ESD wrist strap and take precautions to avoid ESD.

### Remove:

- [Bottom Case](#)
- [Logic Board](#)



## Tools

1. Torx T5 screwdriver, magnetized
2. Black stick
3. Antenna tool



## Steps For Removal



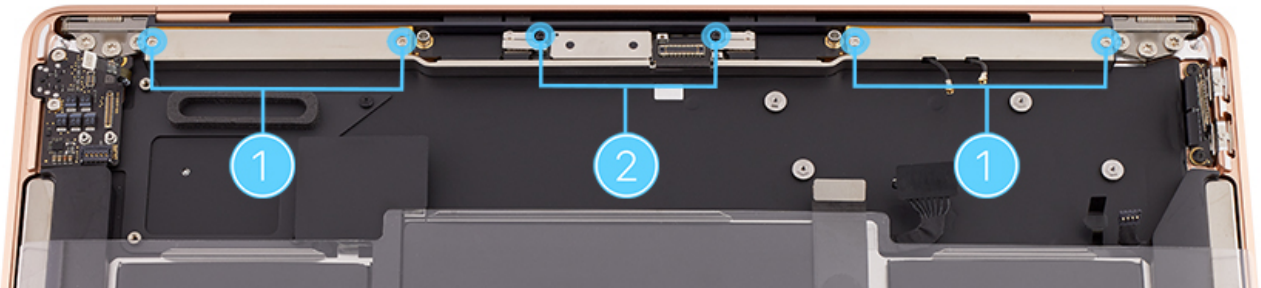
**Caution:** The vent/antenna module is fragile. Be careful not to bend it.

1. Remove the four T5 screws from the vent/antenna module and two T5 screws from the TCON.

1 = T5: 923-03998



2 = T5: 923-03679

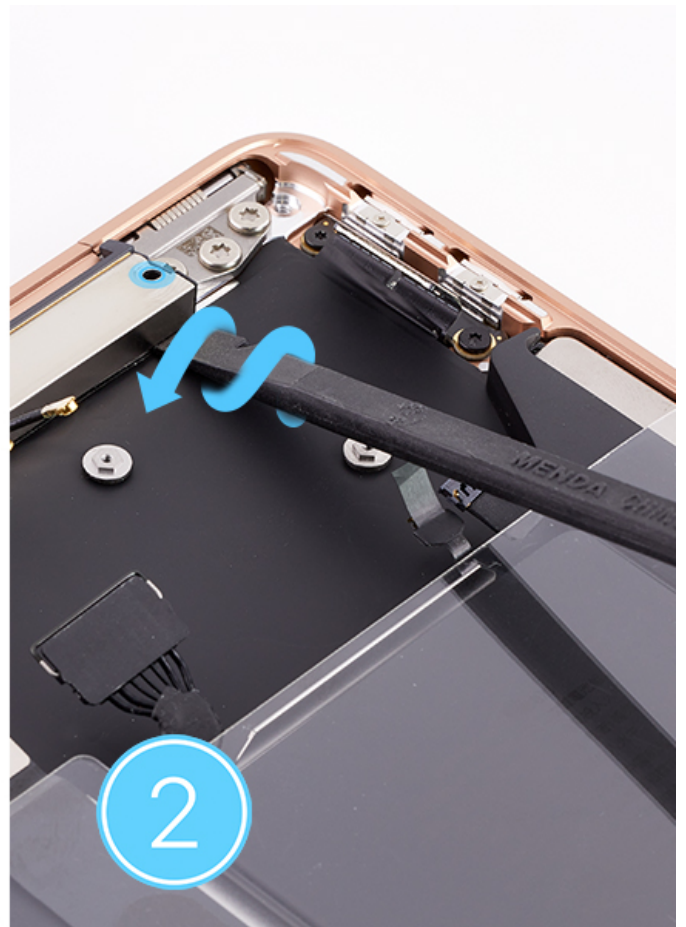


2. Slide the black stick underneath the vent/antenna module at the location of the screw boss. Then rotate the black stick to release the vent/antenna module from the tape on the top case.



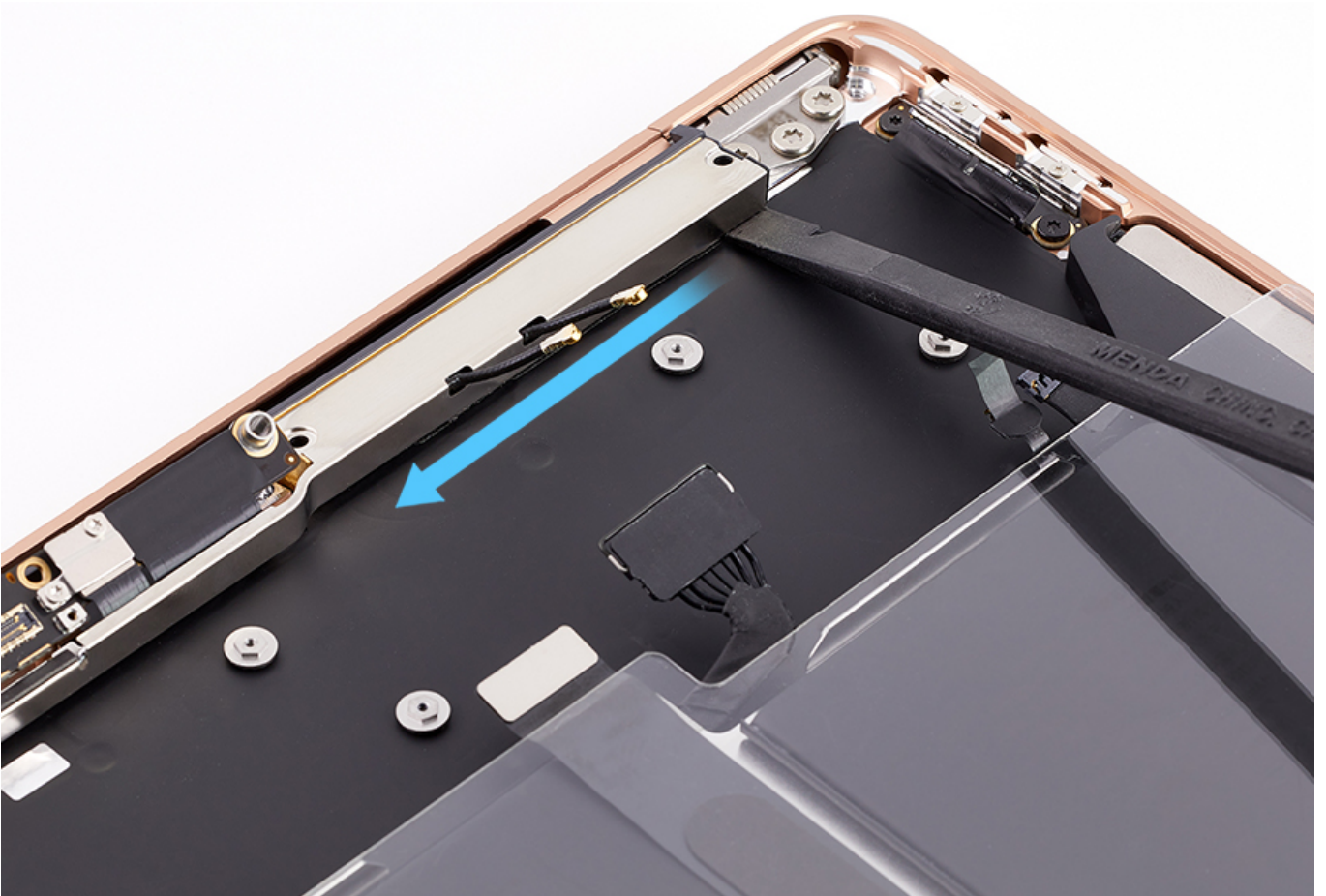


3. Repeat this motion at all four screw bosses.



4. If the vent/antenna module does not release from the tape, slowly and gently slide the black stick under the module to loosen it from the top case.





5. Lift the vent/antenna module out of the top case. Be careful not to damage the TCON.

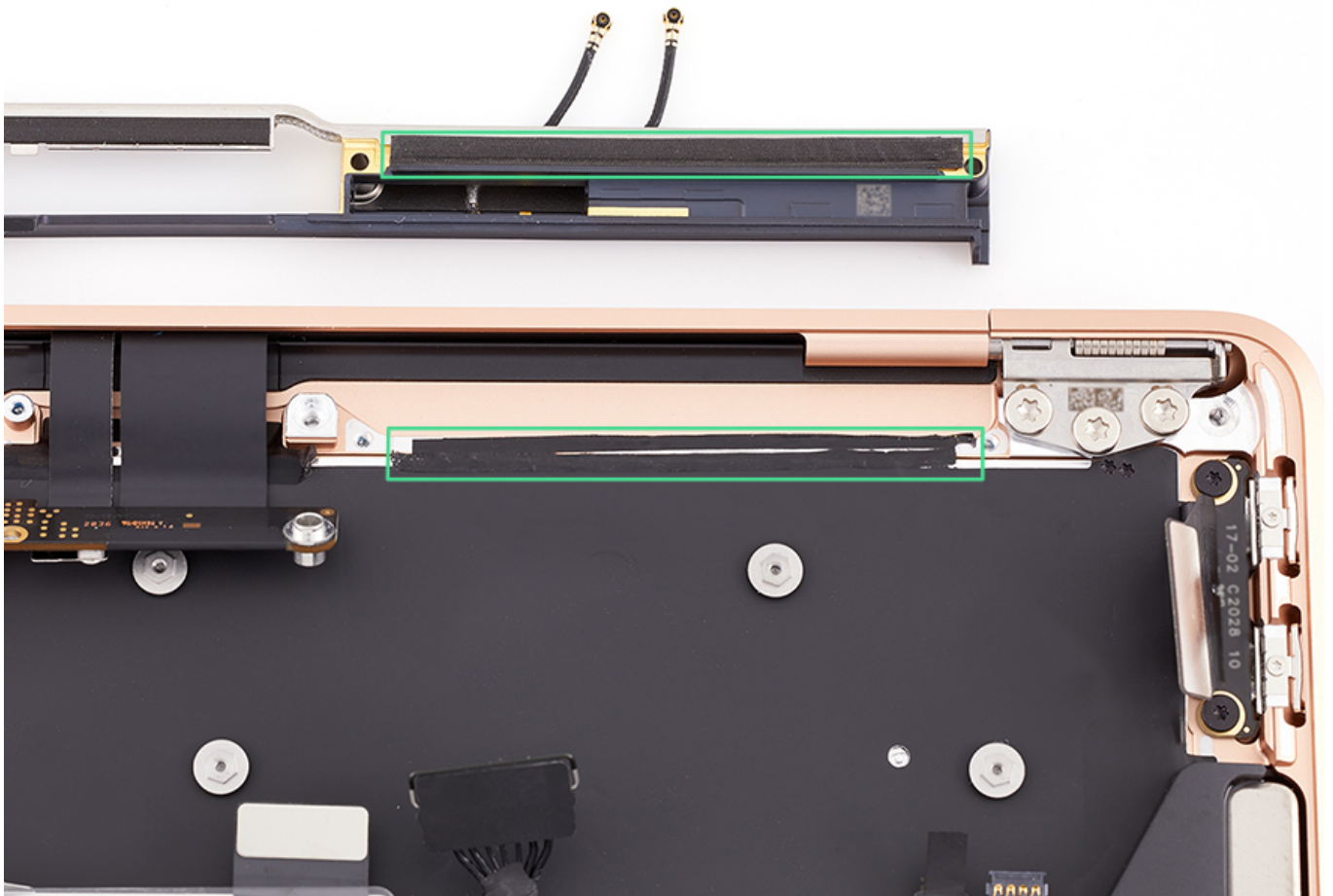
### Steps For Reassembly



1. **Caution:** Before you reinstall the vent/antenna module, inspect the top case and the vent/antenna module for damage to the tape, gasket, or keyboard backlight.

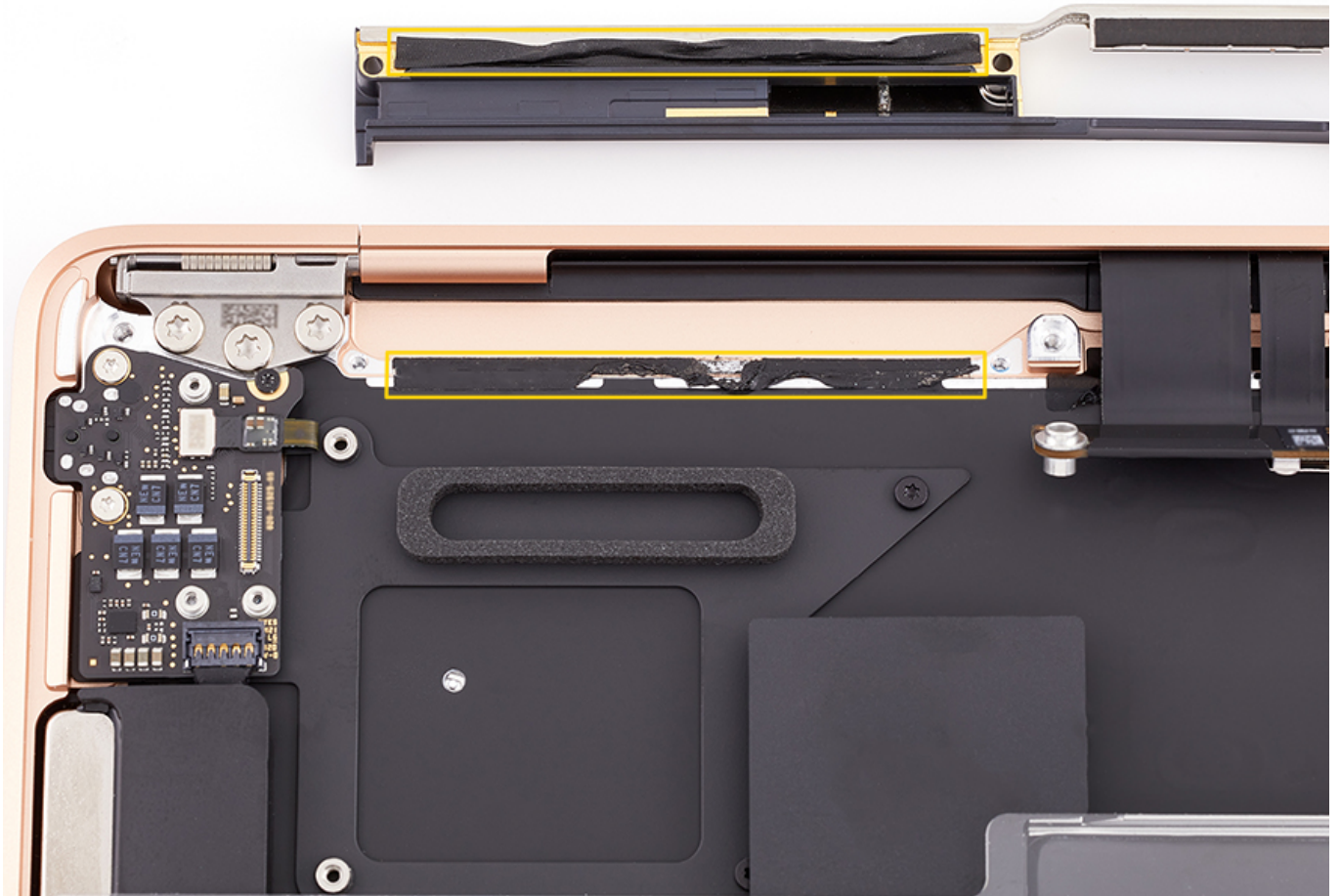
Follow these guidelines:

- If the tape and gasket look like the following examples, continue with procedure.



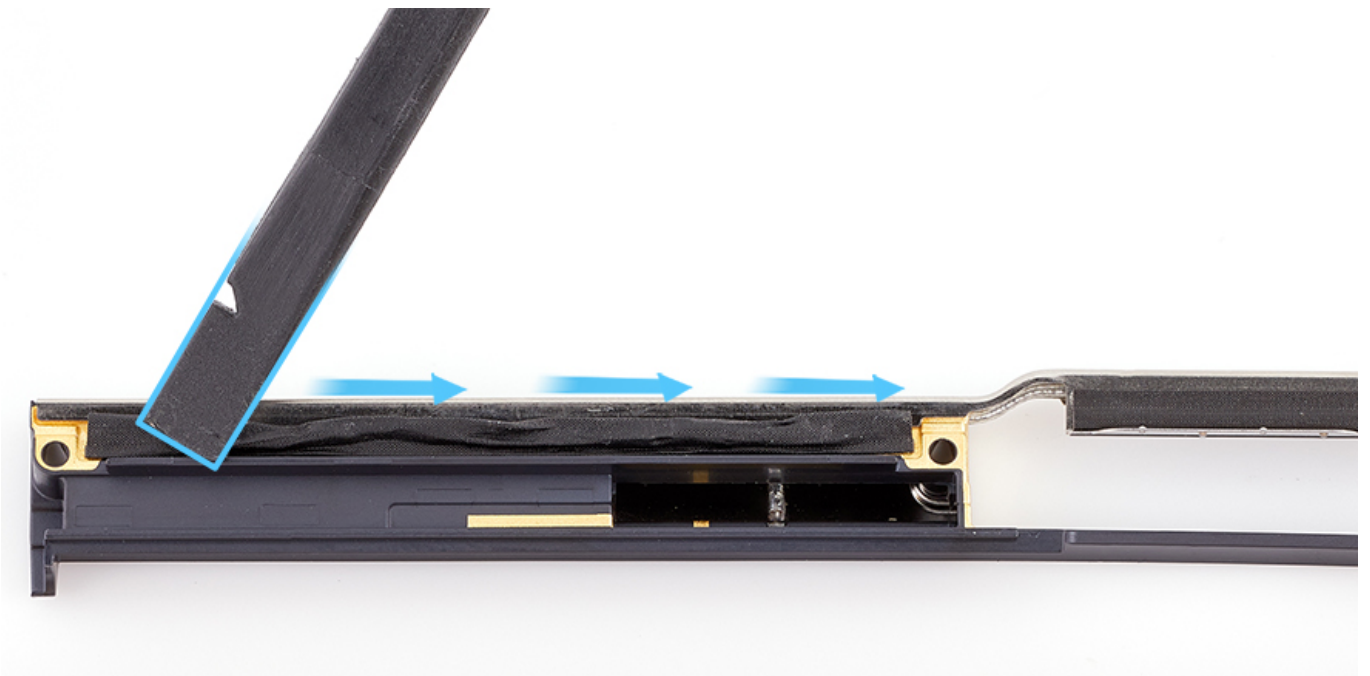
- If the tape and gasket look like the following examples, use a black stick to smooth out the tape and/or gasket.



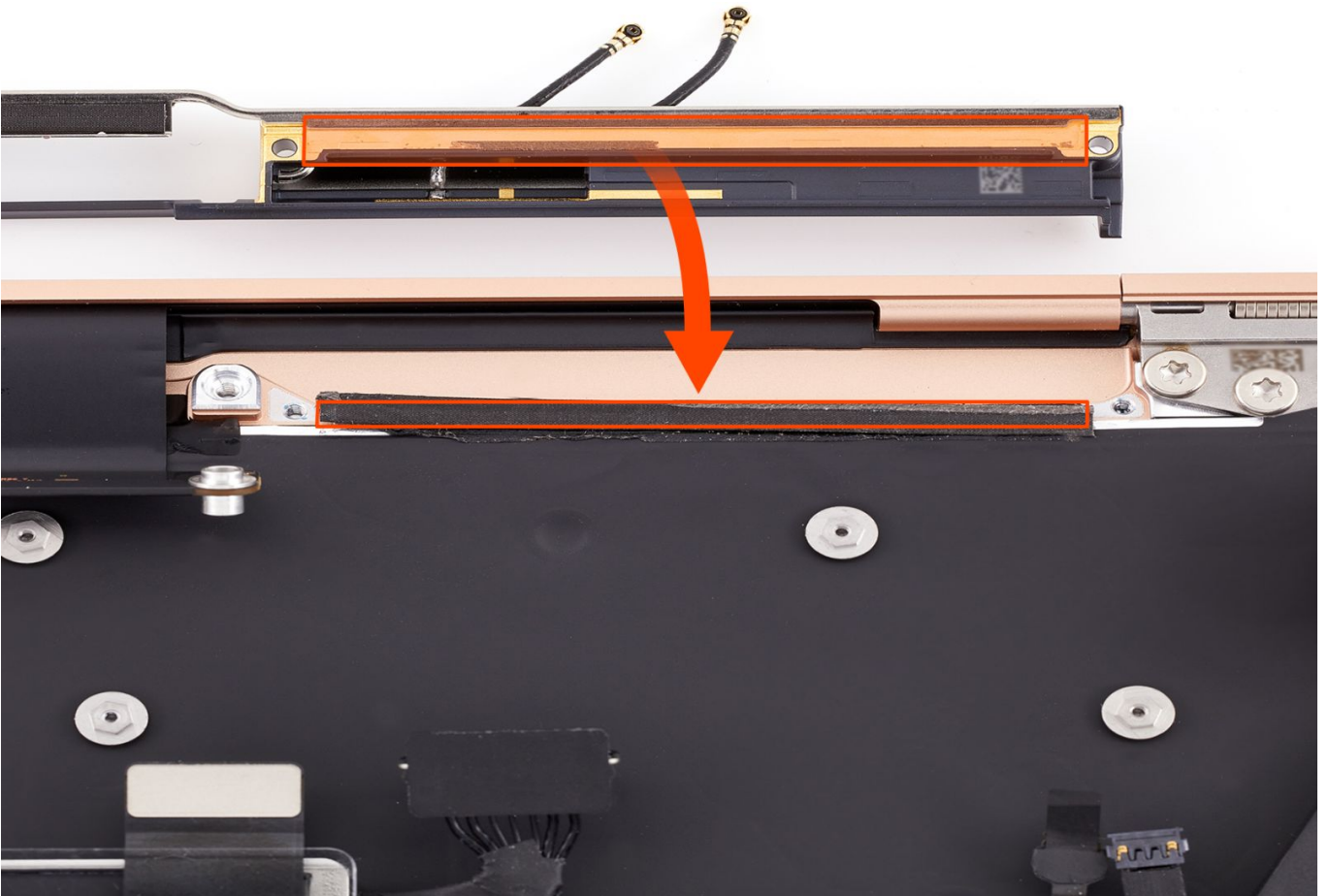


To smooth out the tape use the pointed end of a black stick and to smooth out the gasket use the flat end of a black stick.

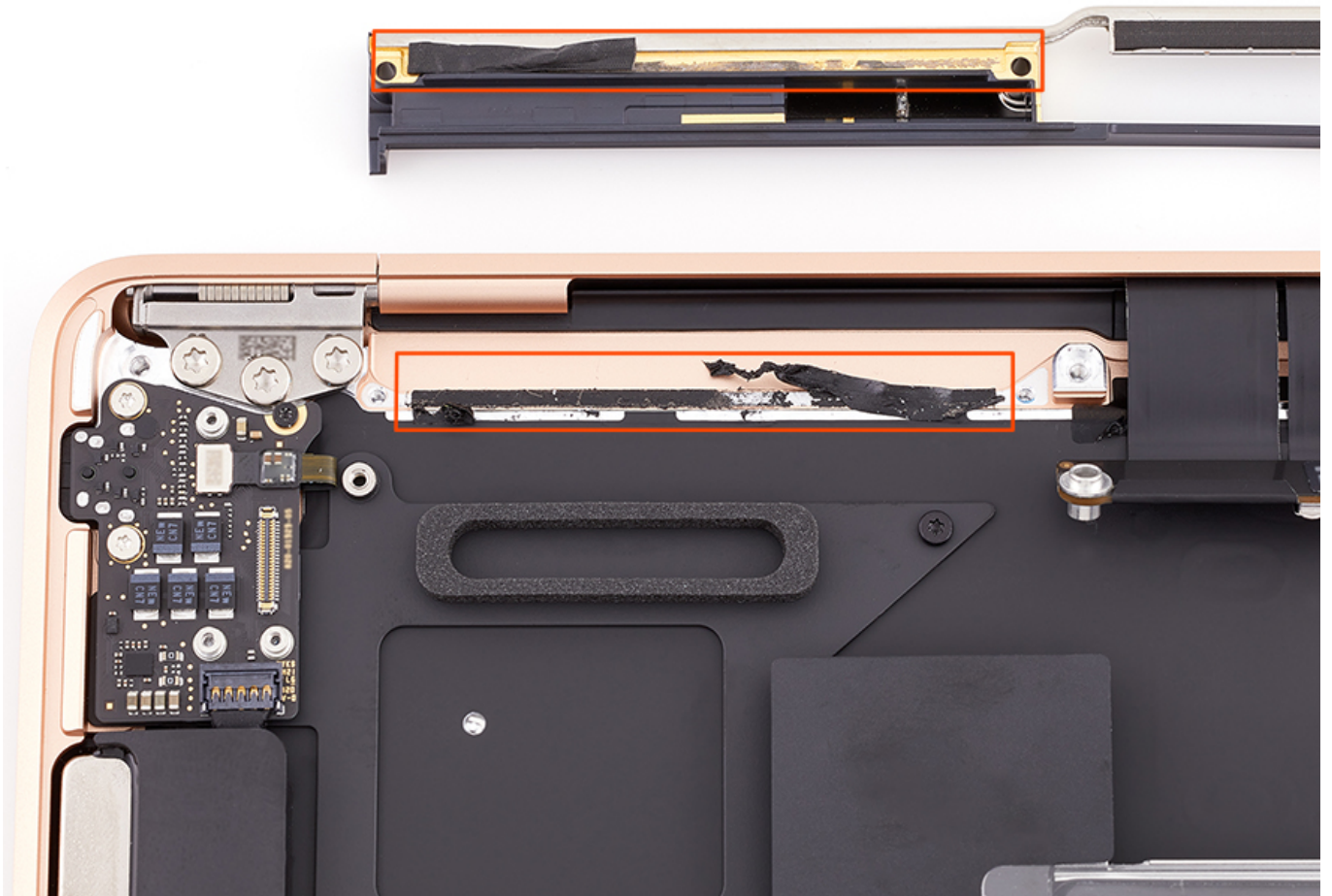




- If the tape and gasket look like the following examples, replace the tape and/or gasket.



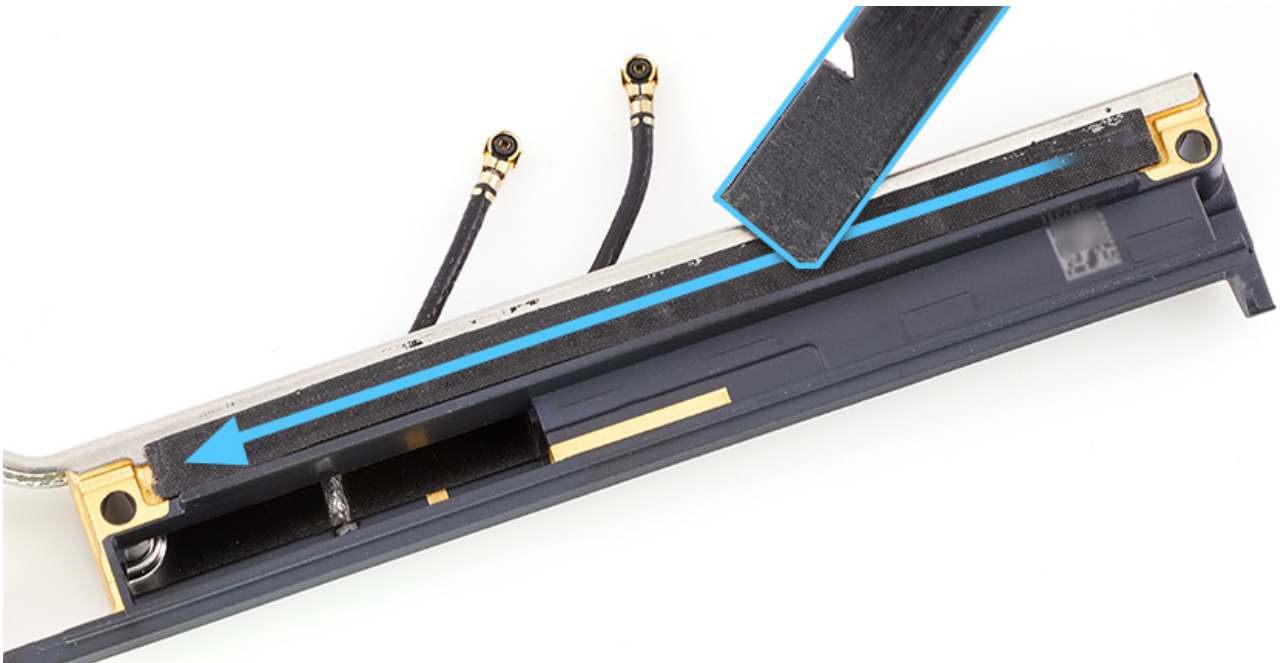




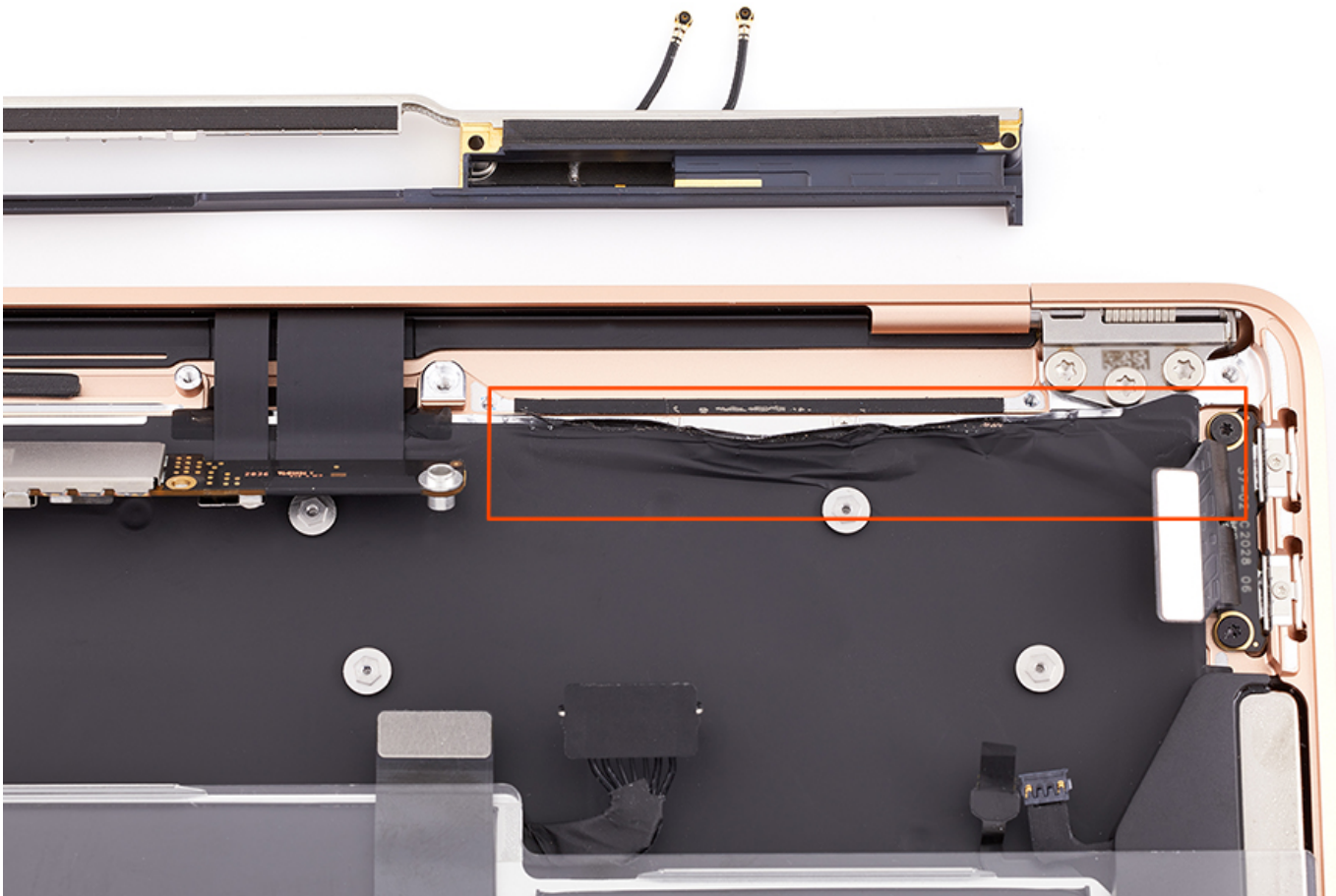
To replace the gasket, use tweezers to align the gasket in the vent/antenna module. Then use a black stick to smooth it into place.



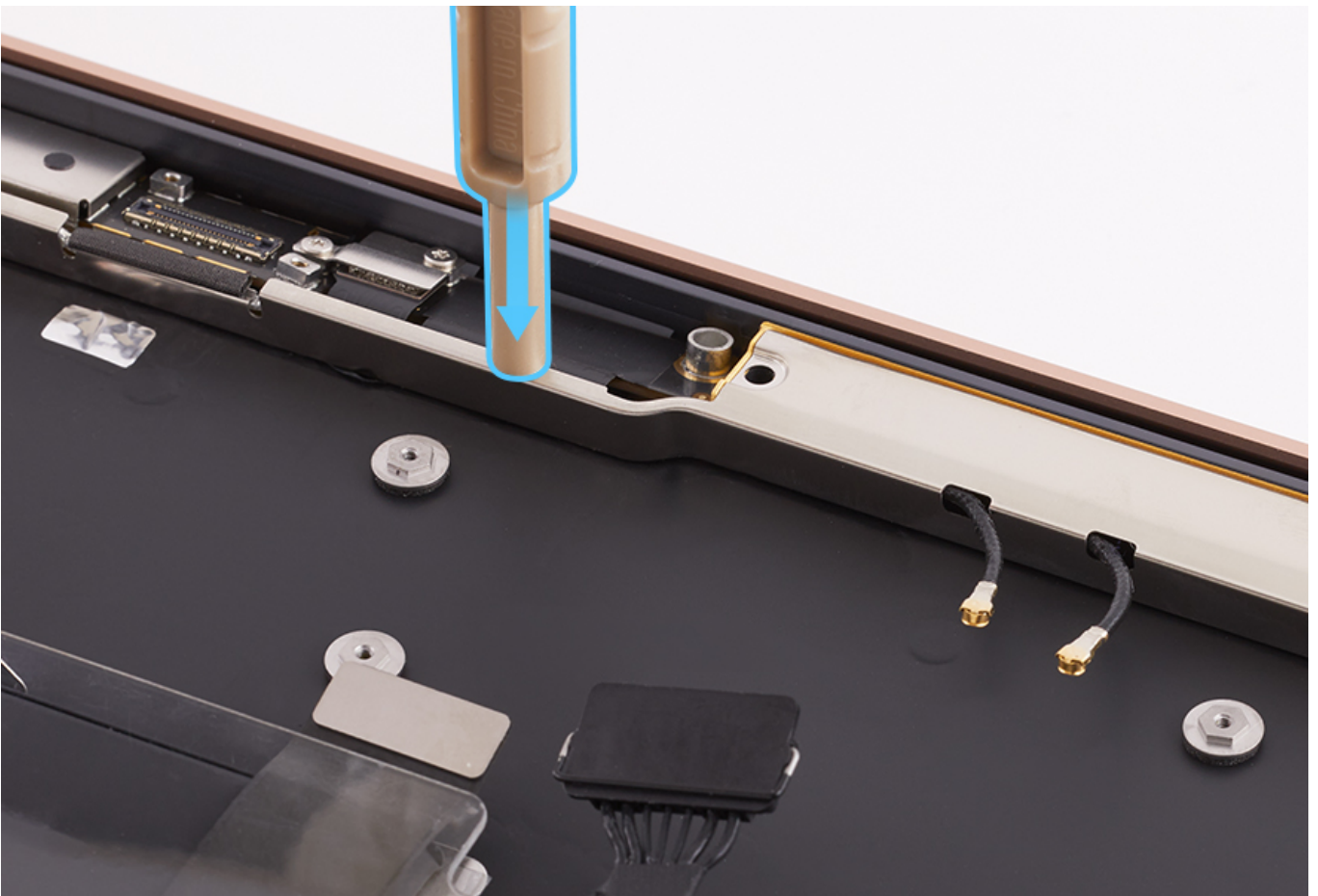




- If the keyboard backlight looks like the following example, replace the top case.



2. Reinstall the vent/antenna module into the top case. Using the blunt end of the antenna tool, push the vent/antenna module in at the middle until the tabs are fully inserted and it feels like it locks in place.



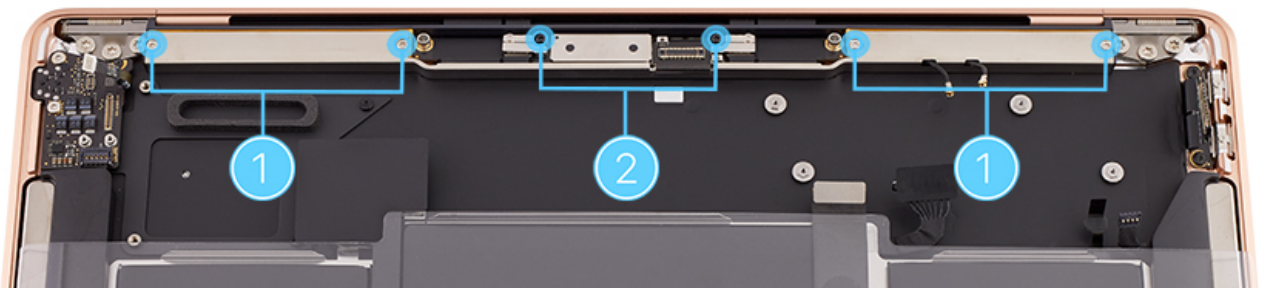
3. Gently wiggle the vent/antenna module to check that it is in place.

4. Reinstall the four T5 screws from the vent/antenna module and two T5 screws from the TCON.

1 = T5: 923-03998



2 = T5: 923-03679



5. Reinstall the [logic board](#) (RP1678).

6. Reinstall the [bottom case](#) (RP1677).

7. **Important:** Run the appropriate [AST 2 diagnostic suites](#) (TP1909).

# MacBook Air (M1, 2020) Display Assembly

## First Steps



### Warning:

- To avoid damaging parts, attach the battery cover and disengage battery power immediately after removing the bottom case.
- Do not apply external power while the computer is under repair.

### Important:

- Only Apple-certified technicians should perform this procedure. For more information, refer to [OP1859: About Apple service certifications](#).
- Wear an ESD wrist strap and take precautions to avoid ESD.
- Completing the [System Configuration](#) (TP1901) suite is required for this procedure. Run the System Configuration suite to configure the replacement part with the computer.

### Remove:

- [Bottom Case](#)
- [Logic Board](#)
- [Vent/Antenna Module](#)



## Tools

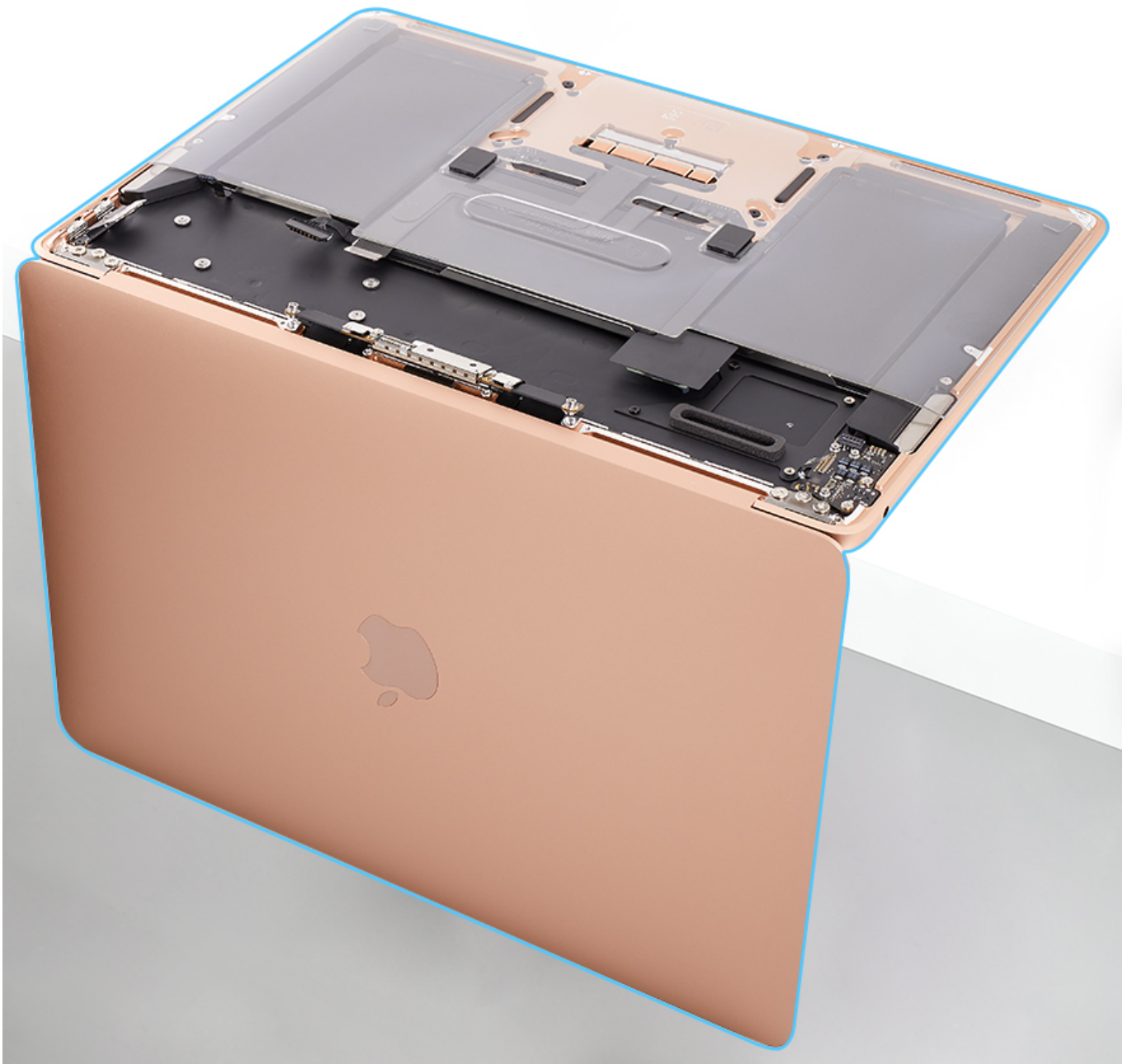
1. Torx T8 screwdriver



## Steps For Removal

1. Open the display and place the computer on the edge of a workbench with the display hanging down.





2. Remove six T8 display hinge screws.

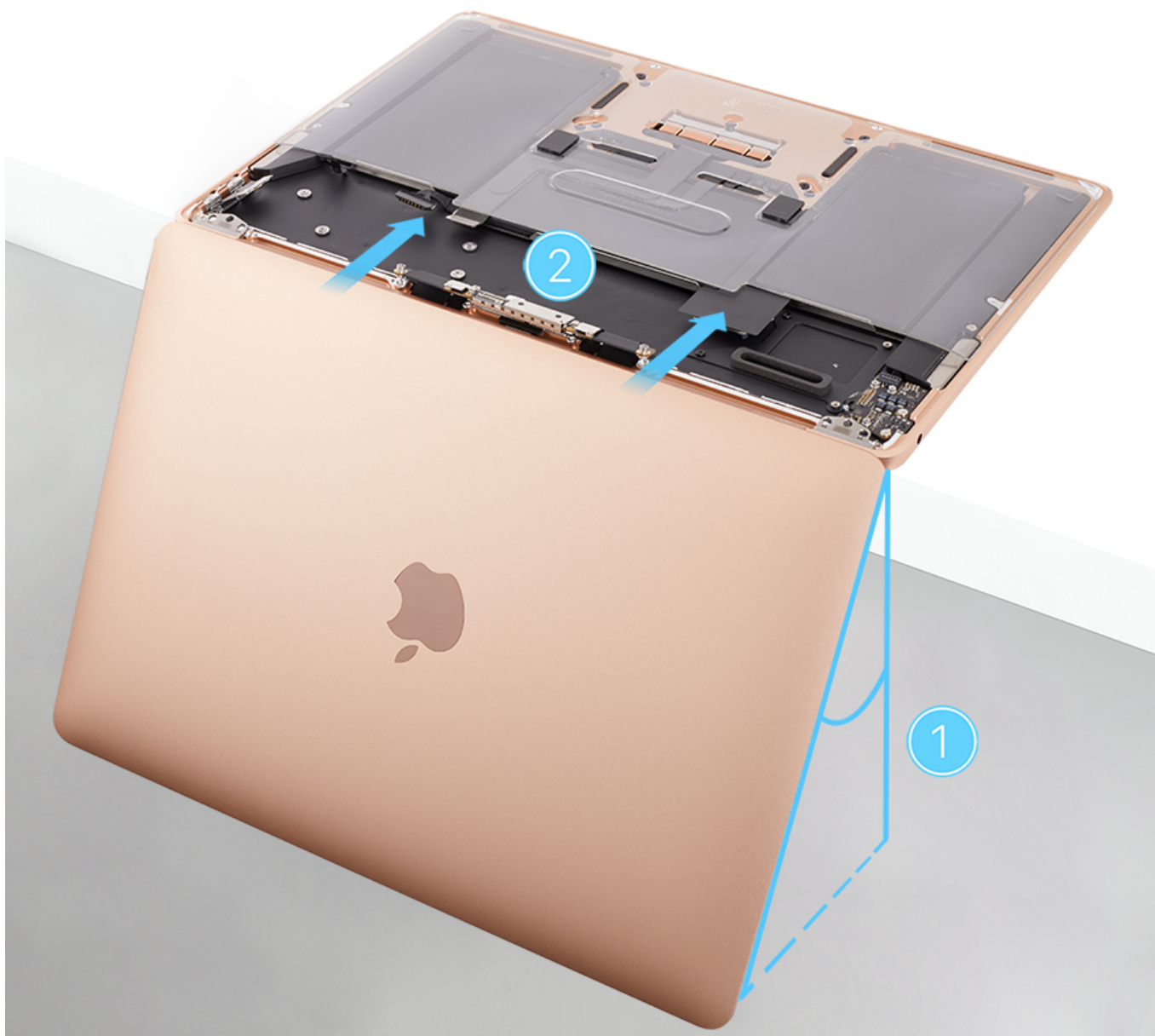
- T8: 923-03997







3. Separate the display assembly from the top case. Pull the display toward you just short of full extension (1), then lift the display up and off the top case (2).



### Steps For Reassembly

**Note:** The display assembly module includes the TCON board and the spring tensioners. When reinstalling the display assembly, be sure the module does not get crimped or caught on the outside of the display.



1. Reinstall the display onto the top case.





2. Loosely reinstall the six T8 display hinge screws in the order shown.



3. Close the top case and check the display alignment. Adjust as necessary until the top case and bottom case are aligned.

4. Tighten all six screws.

5. Reinstall the [vent/antenna module](#).

---

6. Reinstall the [logic board](#).

7. Reinstall the [bottom case](#).

**Important:**

8. Run the [System Configuration](#) (TP1901) suite to configure the replacement part with the computer. Completing the System Configuration suite is required for the display, logic board, and Touch ID board procedures.

9. Run the appropriate [AST 2 diagnostic suites](#) (TP1909).



# MacBook Air (M1, 2020) Top Case Assembly

## First Steps



### Warning:

- To avoid damaging parts, attach the battery cover and disengage battery power immediately after removing the bottom case.
- Do not apply external power while the computer is under repair.

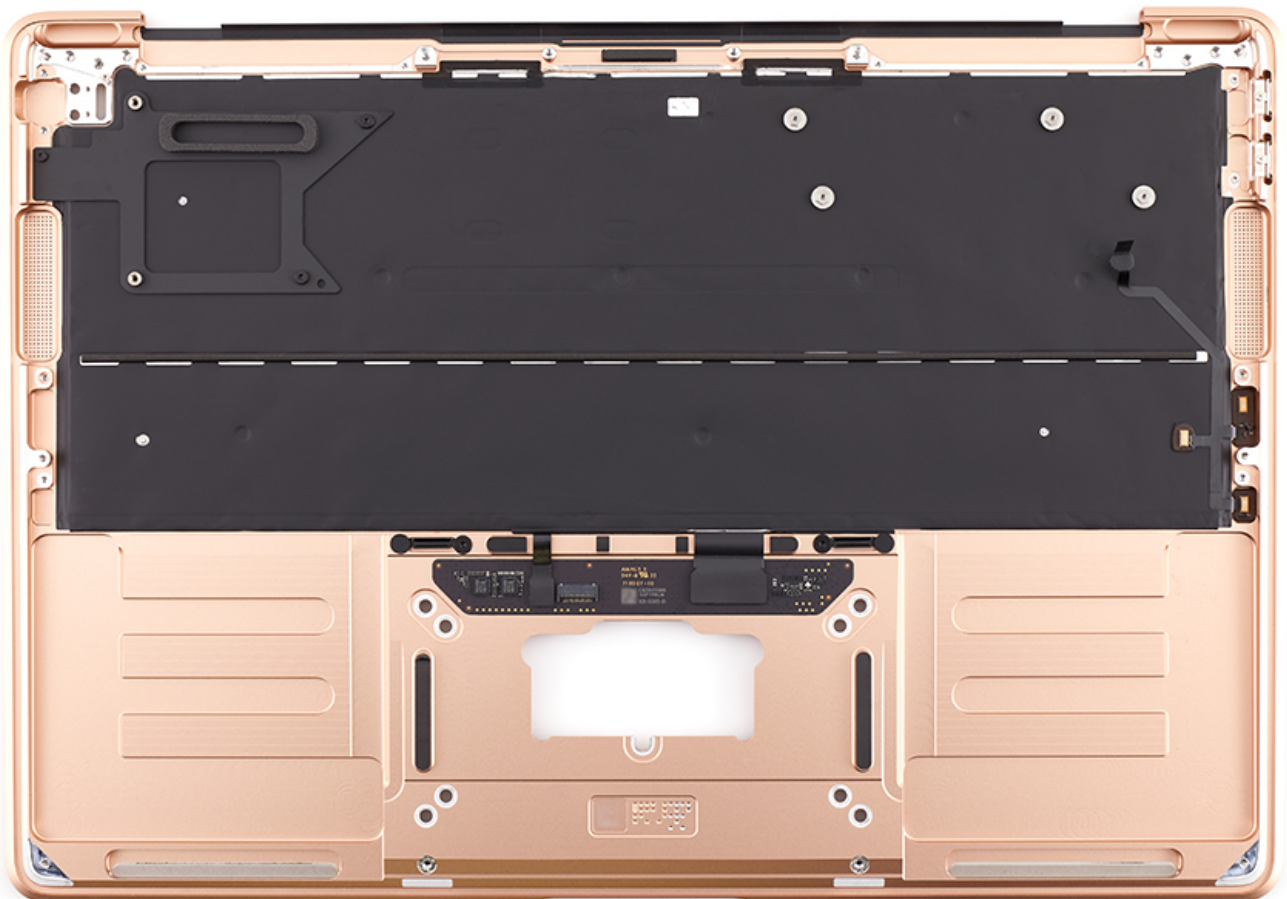
### Important:

- Only Apple-certified technicians should perform this procedure. For more information, refer to [OP1859: About Apple service certifications](#).
- Wear an ESD wrist strap and take precautions to avoid ESD.

**Note:** Regional top cases have the same base part number, but they include a language code prefix (for example, Italian = T661-16831). Confirm the correct keyboard language before replacing the top case. To help determine the correct country code and keyboard language, refer to [How to identify keyboard localizations](#).

### Remove:

- [Bottom Case](#)
- [I/O Board](#)
- [Trackpad](#)
- [Speakers](#)
- [Battery](#)
- [Audio Board](#)
- [Touch ID Board](#)
- [Logic Board](#)
- [Vent/Antenna Module](#)
- [Display Assembly](#)



## Tools

No tools needed.

## Steps For Removal

After all of the first steps are completed, only the top case remains.

These components will also remain in the top case:

- Keyboard
- Microphone
- Keyboard daughter board

## Steps For Reassembly

1. Reinstall the [display assembly](#).
2. Reinstall the [vent/antenna](#).
3. Reinstall the [logic board](#).
4. Reinstall the [Touch ID board](#).
5. Reinstall the [audio board](#).
6. Reinstall the [battery](#).
7. Reinstall the [speakers](#).
8. Reinstall the [trackpad](#).
9. Reinstall the [I/O Board](#).
10. Reinstall the [bottom case](#).
11. Run the appropriate [AST 2 diagnostic suites](#) (TP1909).

# System Configuration for Mac Computers with Apple Silicon



**Important:** If you replace the logic board in the user's computer, ensure the user has their data backed up. Data can't be recovered after the System Configuration suite is run.

## Contents of this article:

- [About System Configuration](#)
- [When System Configuration is Required](#)
- [Before Starting an Apple Service Toolkit 2 \(AST 2\) Session](#)
- [System Configuration Steps](#)
- [Troubleshooting Tips](#)

## About System Configuration

The AST 2 System Configuration suite is a required repair completion tool that configures a Mac after certain repair procedures. These repair procedures aren't complete until you successfully run the System Configuration suite. The System Configuration suite is not a diagnostic substitute and [post-repair diagnostic testing](#) (TP1909) must be completed after every repair.

System Configuration for Mac computers with Apple silicon has been simplified:

- A host computer is no longer required
- DFU mode is no longer required

**Important:** If you are attempting to complete the repair of an Intel-based Mac with the Apple T2 Security Chip, refer to [TP1657: System Configuration for Mac Computers with the Apple T2 Security Chip](#).

Successfully running the System Configuration suite:

- Ensures repair quality and compliance with regional communications regulations.
- Enables hardware encryption, biometric authentication, and secure startup protection.
- Optimizes performance and verifies proper configuration of hardware components.
- Conducts tests that verify that you correctly replaced parts and correctly reconnected parts during the repair, including the Touch ID sensor, ambient light sensor, Touch Bar, display, and camera.
- Pairs the Touch ID sensor and Touch Bar to the logic board and updates their calibration values for performance optimization.
- Writes the system serial number to the new logic board and reports it to Apple (if you replaced the logic board).  
**Note:** Reporting the logic board serial number to Apple enables iCloud services including FaceTime, Messages, and Apple Pay, and assigns the wireless region.
- You can see the completed steps in the AST 2 Diagnostic Console by selecting the suite in Diagnostics Results and clicking Details.

**Note:** For the purpose of this procedure the term Unit Under Test (UUT) will be used to describe the user's computer.

## When System Configuration is Required

### Perform System Configuration after these parts are replaced:

Model	Display	Logic Board	Top Case	Touch ID Board
MacBook Air (M1, 2020)	•	•		•
MacBook Pro (13-inch, M1, 2020)	•	•	•	•
Mac mini (M1, 2020)		•		

**Important:** If you replaced the logic board, run the System Configuration suite, then [use Apple Configurator 2](#) (TP1954) to install the latest version of macOS, macOS Recovery, and update the firmware.

## Before Starting an AST 2 Session

1. Add the parts you replaced to the repair system.
2. Enter the known-bad board (KBB) and known-good board (KGB) serial numbers into the repair system.

### Caution:

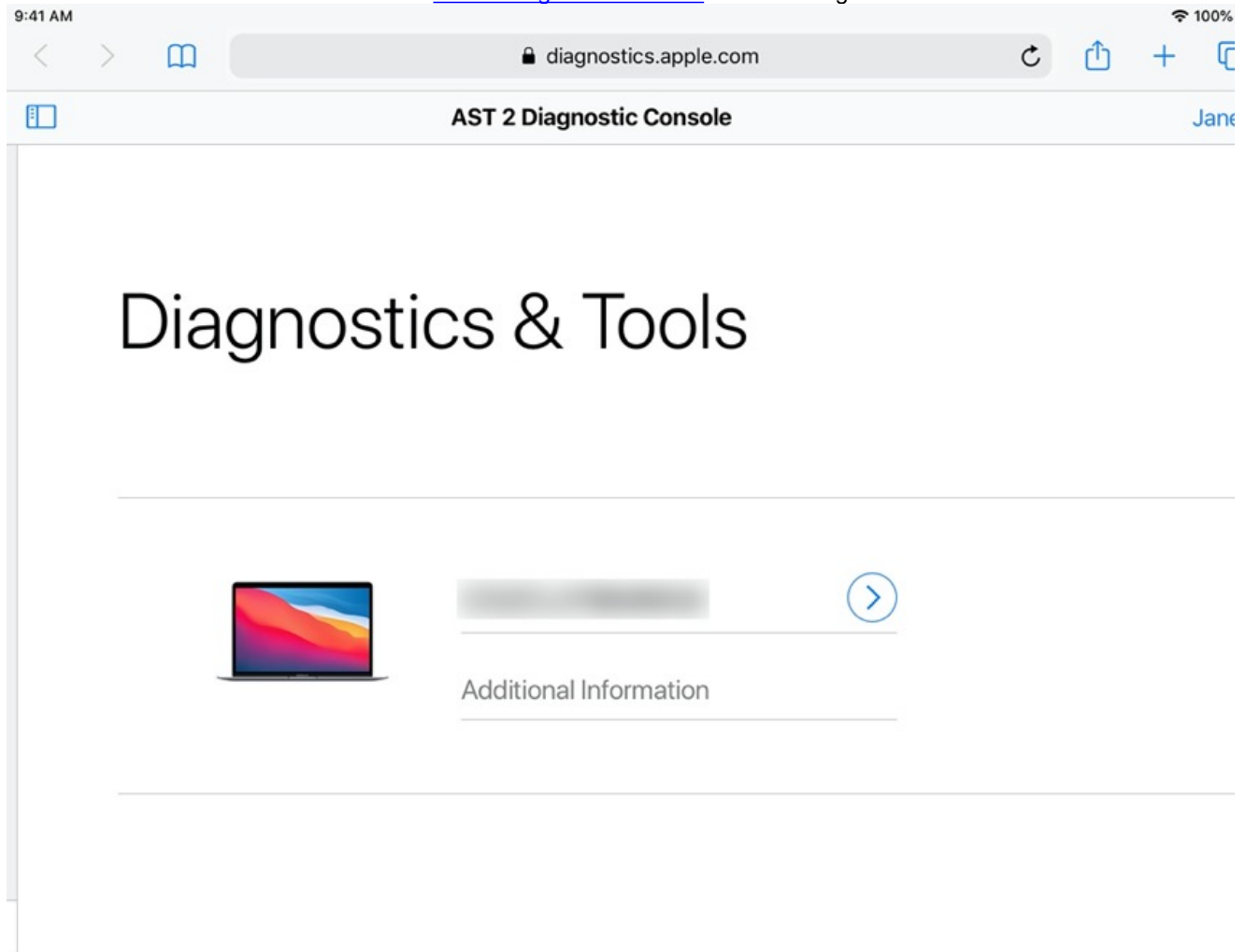
- You must use upper case characters for letters in the logic board serial number. To ensure accuracy, it is

- recommended to scan the 2D barcode.
  - If you enter wrong serial numbers or don't save the repair, the System Configuration suite won't become available.
3. Save the repair.

## System Configuration Steps

For additional guidance, watch the [Post-Repair Procedures](#) (SV461) service video.

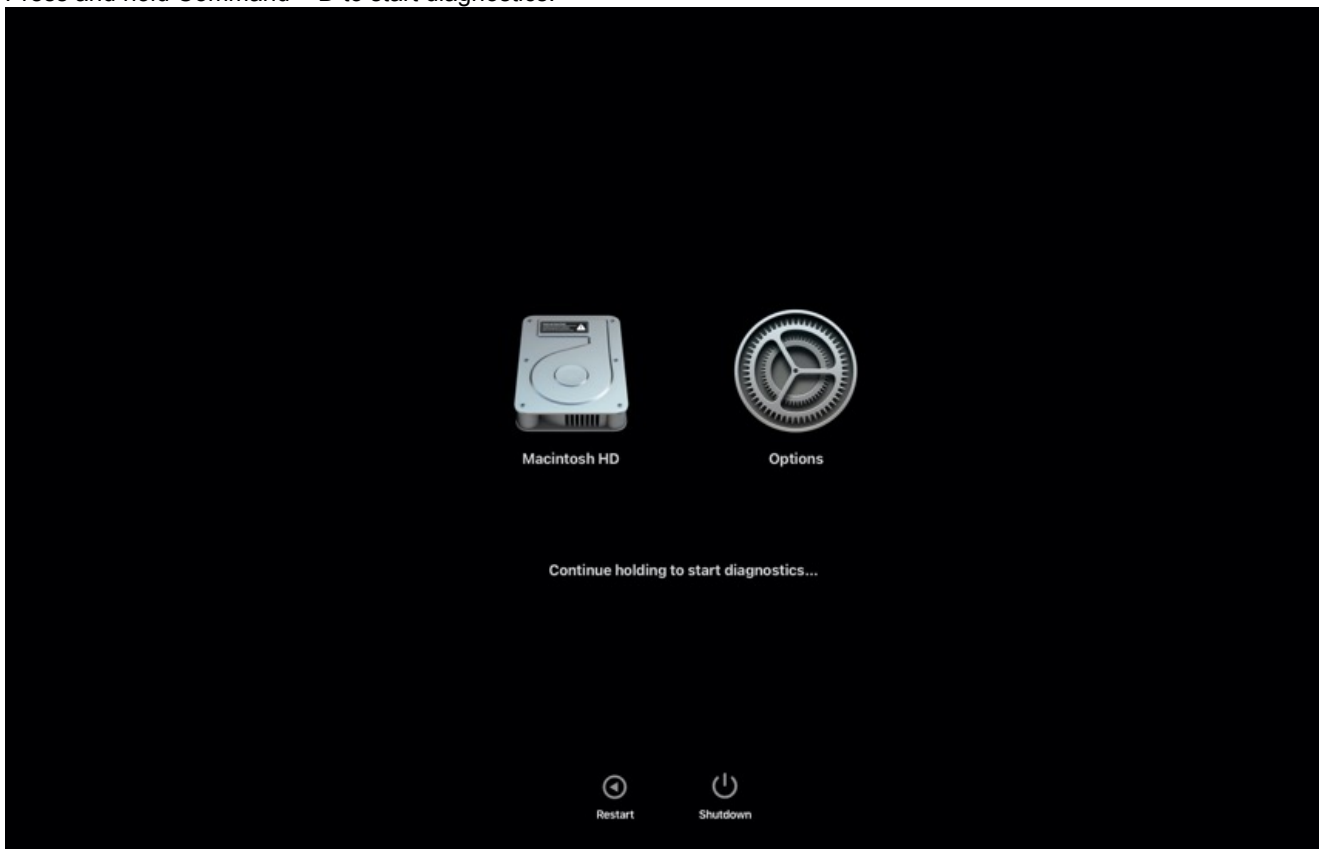
1. Enter the serial number of the UUT in the [AST 2 Diagnostic Console](#) to start a diagnostic session.



2. On the UUT, press and hold the power button for 10 seconds to start up to startup options.  
**Important:** After replacing a logic board, the UUT will automatically start up in Diagnostics Mode, during which you'll hear the UUT chime twice. Skip to step 4.

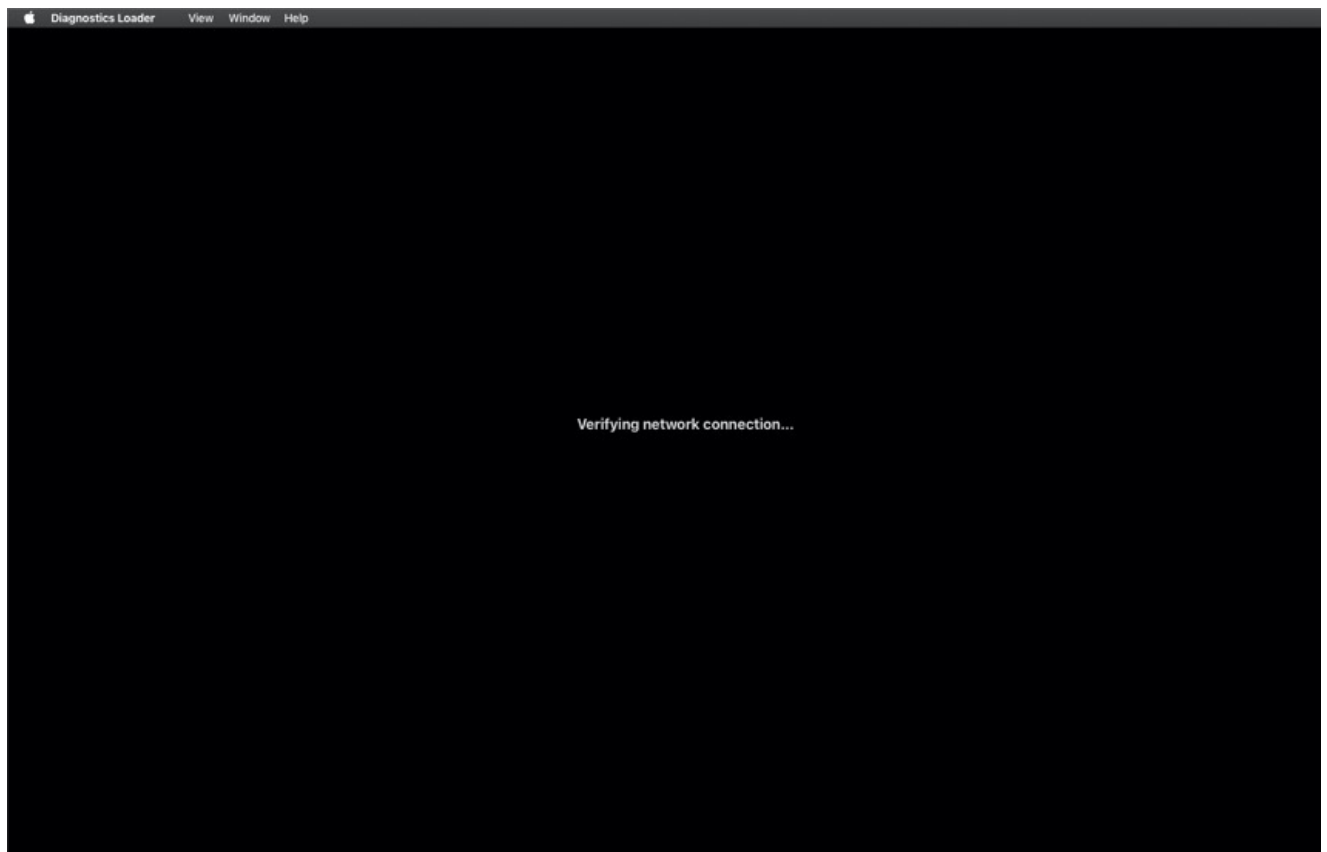


3. Press and hold Command + D to start diagnostics.

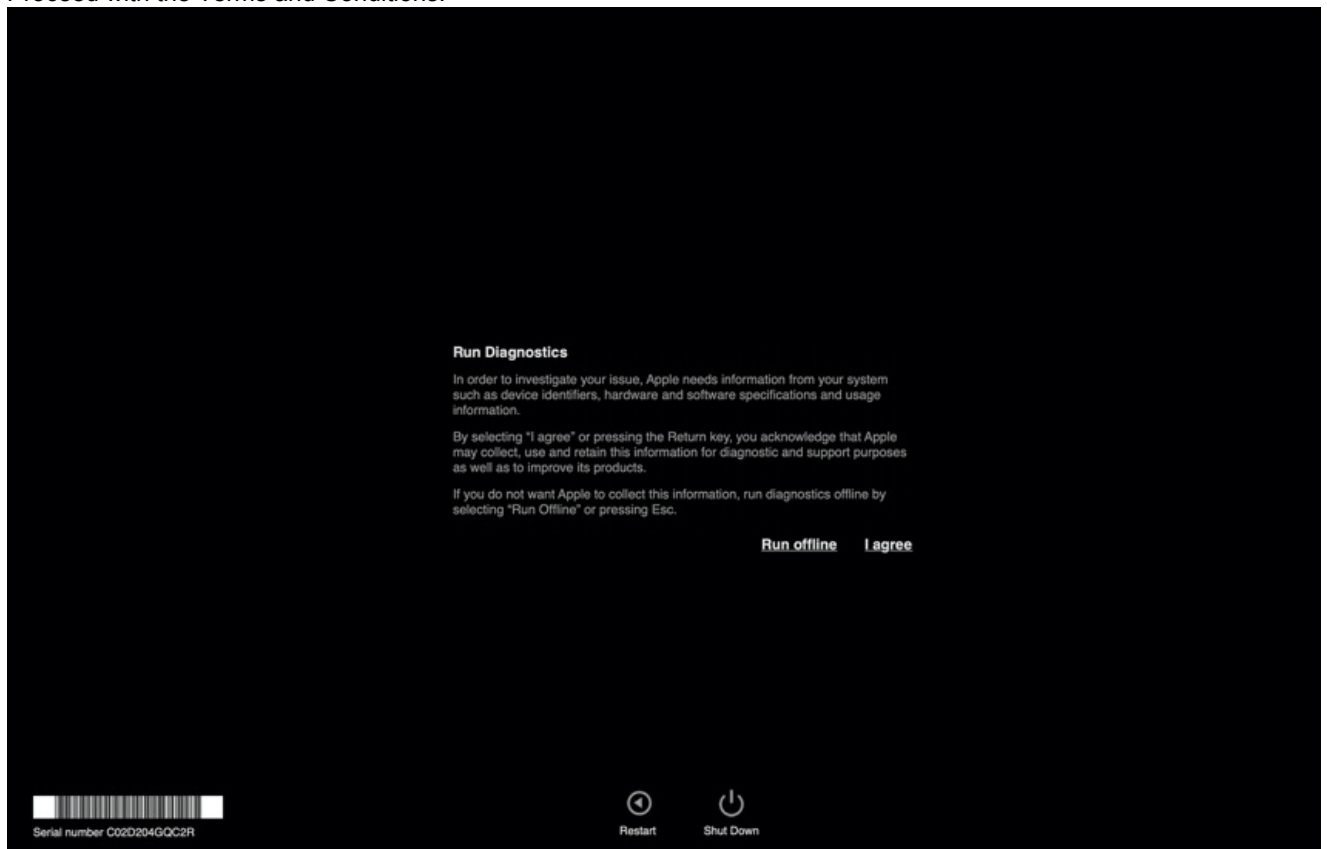


4. Connect to the network (Wi-Fi or Ethernet).

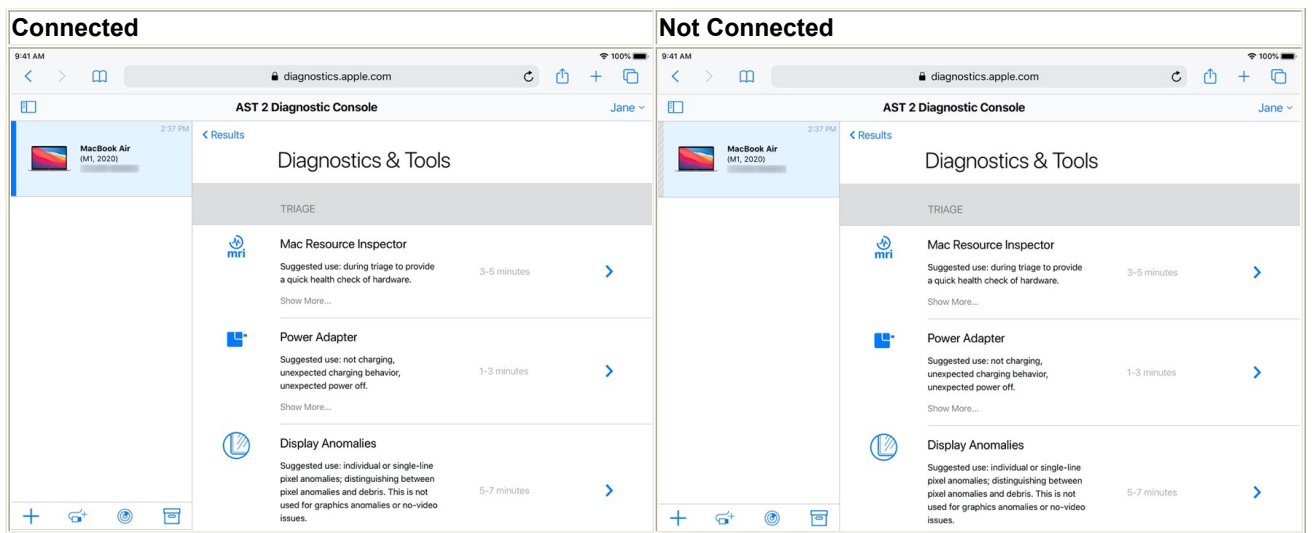




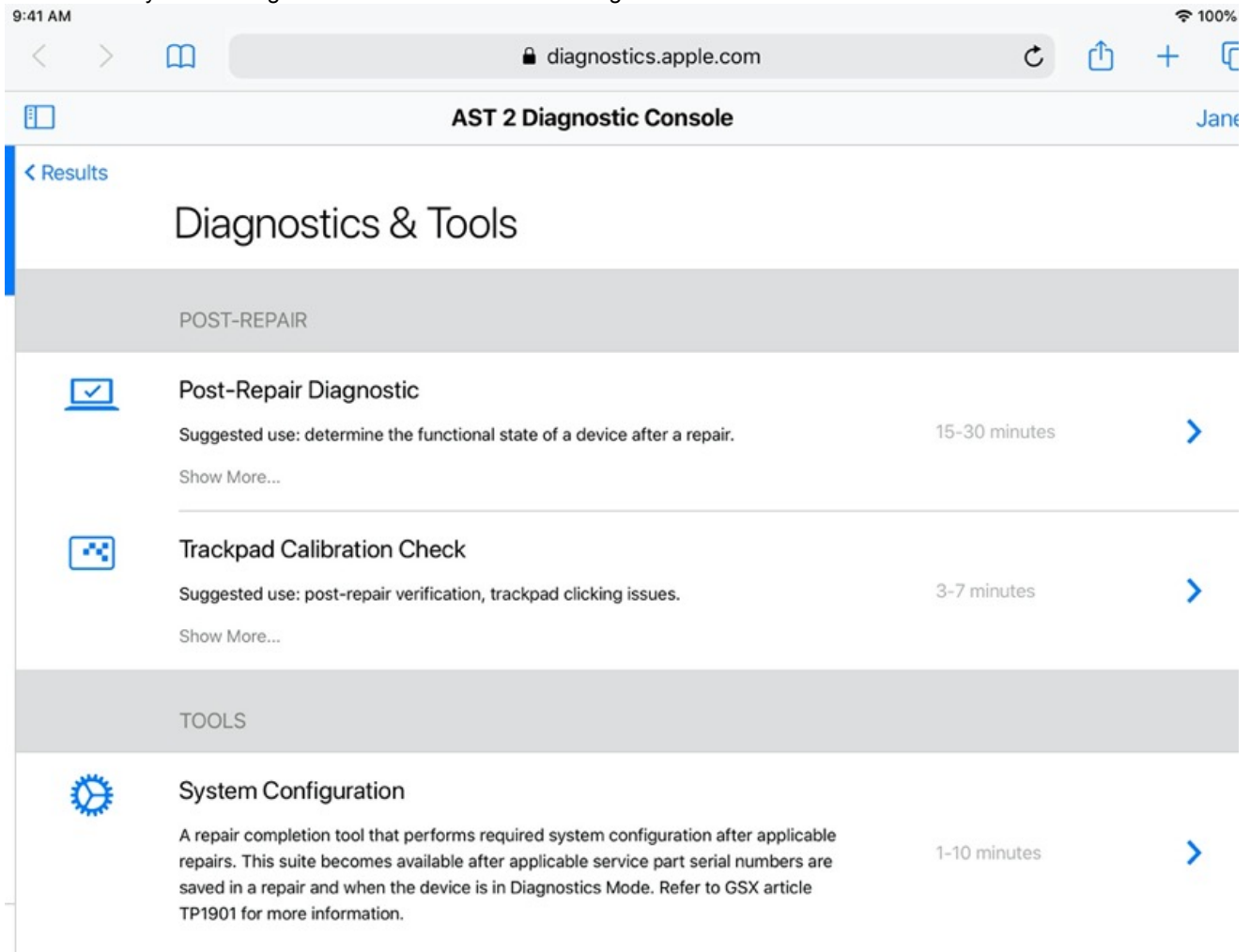
5. Proceed with the Terms and Conditions.



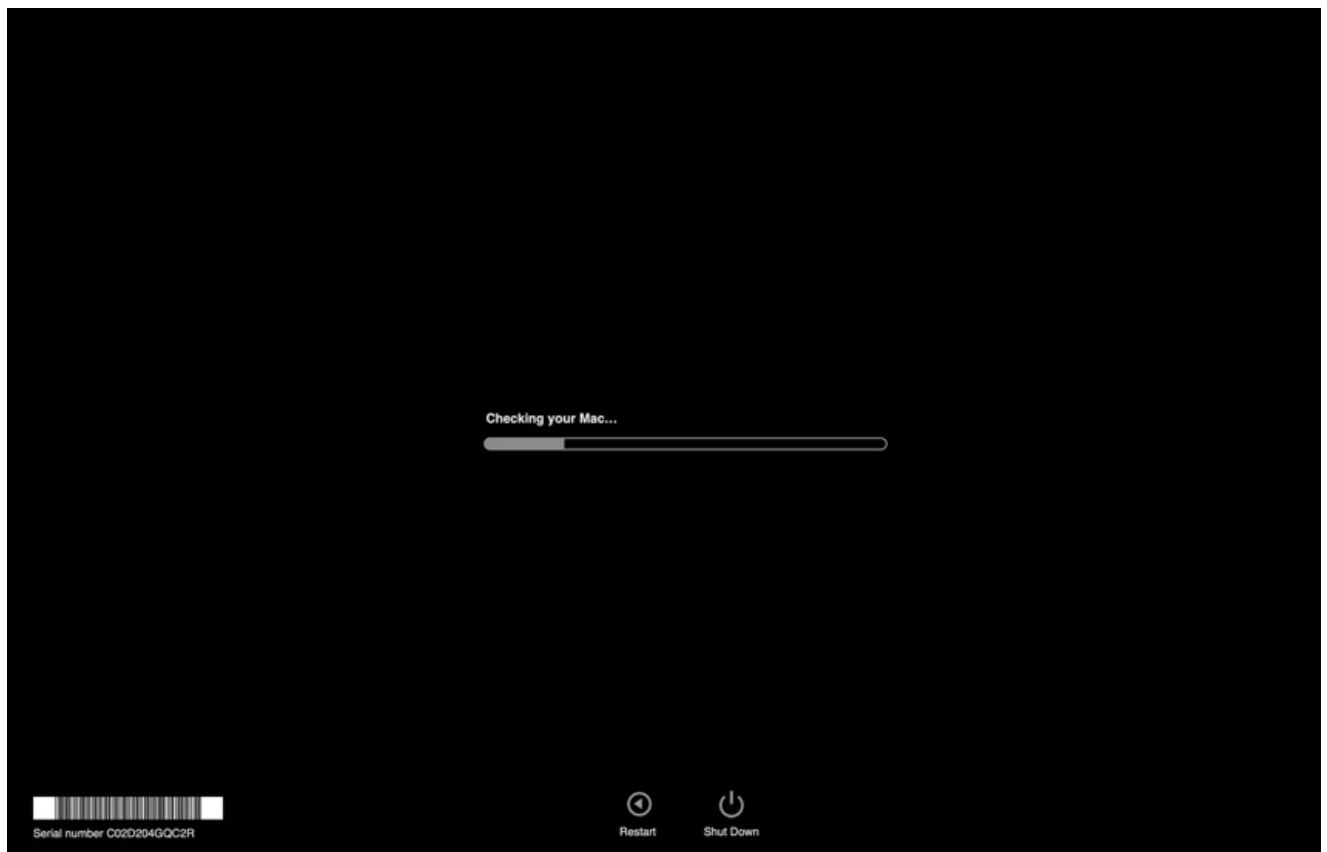
6. Confirm that a blue bar is next to the UUT in the AST 2 Diagnostic Console.  
**Important:** Refer to the Troubleshooting Tips section at the bottom of this article if the bar next to the UUT does not turn blue.



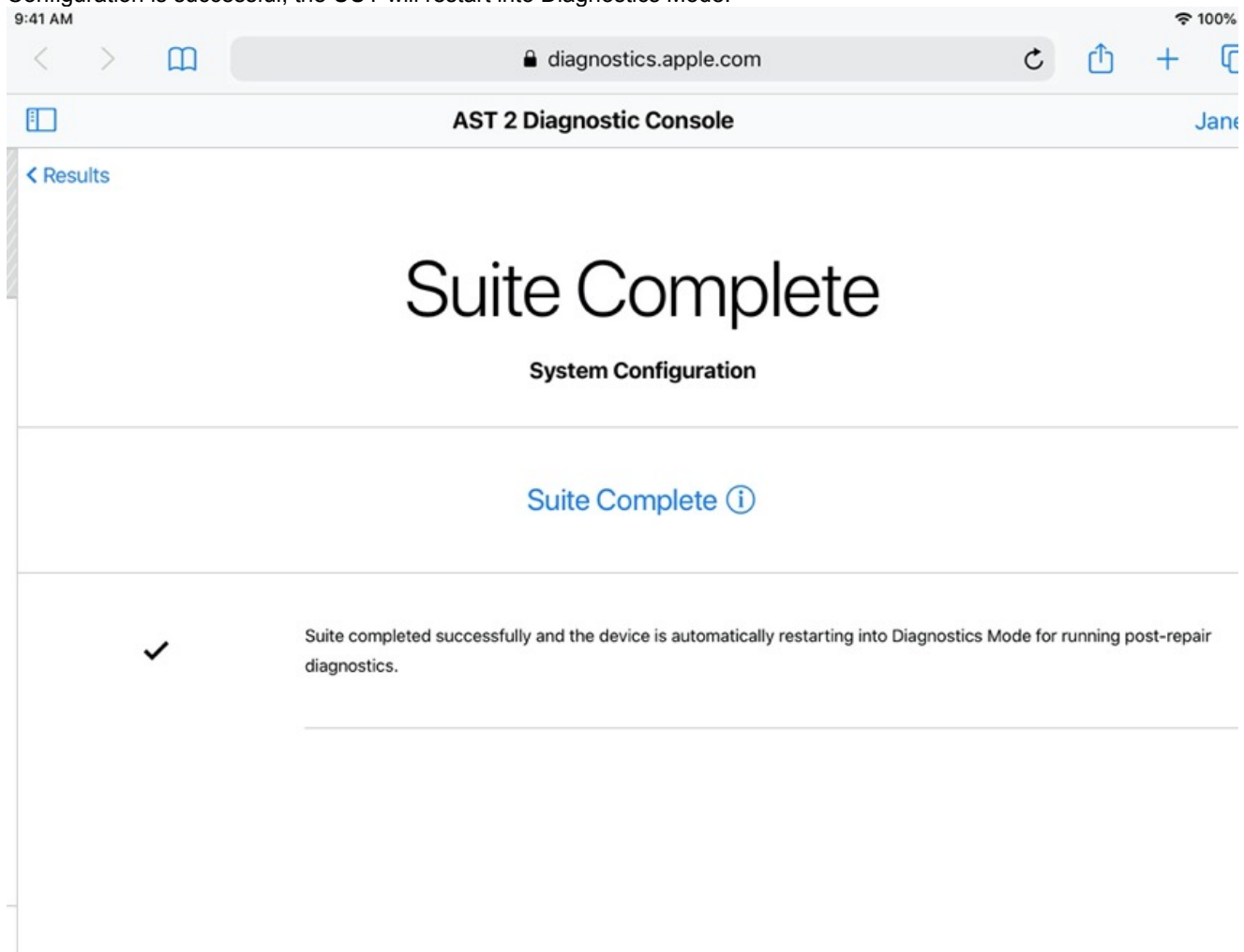
7. Choose the System Configuration suite from the AST 2 Diagnostic Console.



8. The UUT will begin to run the System Configuration suite and will show a progress bar on the display.



9. Results will appear in the AST 2 Diagnostic Console once the System Configuration suite is complete. If System Configuration is successful, the UUT will restart into Diagnostics Mode.



10. If issues are found and the System Configuration suite fails, follow the instructions on the AST 2 Diagnostic Console and escalate to Channel Service Support (CSS).

**Important:**

- If you replaced the logic board, follow the restore steps in the [Apple Configurator 2 User Guide](#) to install the latest

version of macOS, macOS Recovery, and update the firmware. Additional details are available in [TP1954: When to use Apple Configurator 2 for Mac Computers with Apple Silicon](#).

- Run the necessary [post-repair diagnostic tests and suites](#) (TP1909) to ensure a successful repair.
- For notebooks, ensure you run [trackpad calibration check](#) (TP1314) anytime the computer is opened.

## Troubleshooting Tips

- If the UUT does not activate (the gray bar doesn't turn blue) in the AST 2 Diagnostic Console, verify the following information:
  - The UUT is connected to the internet over Wi-Fi or Ethernet.
  - The UUT system serial number is correctly entered in the AST 2 Diagnostics Console and matches the serial number used to create the repair.
  - You correctly added the parts to the repair, the KBB and KGB part serial numbers are correct, and the repair has been saved.
- If the System Configuration suite isn't available, perform the following steps in the order listed:
  1. Verify the troubleshooting steps above.
  2. Archive and restart the diagnostic session.
  3. Restart the UUT into Diagnostics Mode.
  4. Open the UUT and confirm that all parts are properly installed and all flex cables are securely connected.
  5. If it has been more than 14 days since a logic board, top case, or display KGB serial number was added to the repair, escalate to CSS.
- If the diagnostic session is interrupted (the blue bar turns gray), perform the following steps:
  - Archive and restart the diagnostic session.
  - Check the network connection.
  - Open the UUT and confirm that all parts are properly installed and all flex cables are securely connected.
- Change the language on the UUT
  - The diagnostic session language on the UUT is determined by the language set in the user's macOS. If you need to change the language, start up the computer to the user's macOS and select a different language.

# Trackpad Calibration Check

## Trackpad Calibration Check

To verify that the trackpad is responding as expected, the Trackpad Calibration Check suite in AST 2 should be run after every repair, including when only the bottom case has been removed and reinstalled.

**Note:** It is recommended to also run the Trackpad (OS) suite after a top case has been replaced, or if the user is having issues related to trackpad functionality.

### Required Tools:

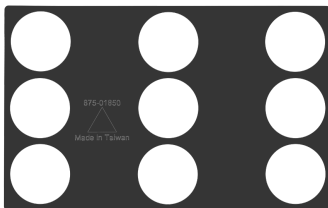
1. Weight Placement Rubber Template (model specific)
  - Refer to the Weight Placement Rubber Template section below to identify the correct template to use.
  - **Important:** If the Weight Placement Rubber Template edges start to curl, order a new pack. Templates come in a pack of three.
2. 200 g and 800 g weights (923-00462)



### Weight Placement Rubber Templates:

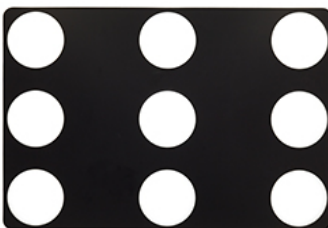
MacBook (Retina, 12-inch, Early 2015, Early 2016, and 2017)

- **923-00555**



MacBook Air (Retina, 13-inch, 2018, 2019, and 2020) and MacBook Air (M1, 2020)

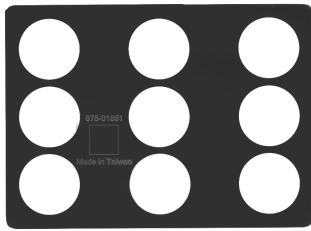
- **923-02462**



MacBook Pro (Retina, 13-inch, Early 2015) and (Retina, 15-inch, Mid 2015)

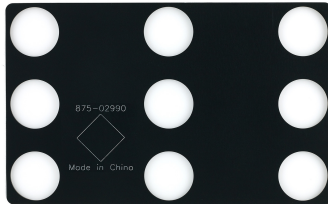
- **923-00599**





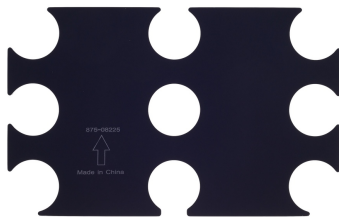
MacBook Pro (13-inch, 2016, 2017, 2018, 2019)

- **923-01316**



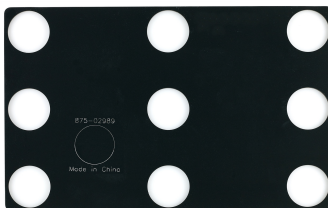
MacBook Pro (13-inch, 2020) and MacBook Pro (13-inch, M1, 2020)

- **923-04161**



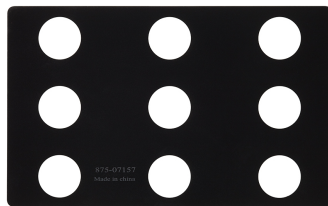
MacBook Pro (15-inch, 2016, 2017, 2018, 2019)

- **923-01317**



MacBook Pro (16-inch, 2019)

- **923-03890**



### Steps:

1. Place the appropriate Weight Placement Rubber Template on the trackpad before launching the Trackpad Calibration Check suite in AST 2. This establishes the correct baseline for the weights.
- Important:** Do not tape the Weight Placement Rubber Template to the top case. Tape may cause inaccurate test results.



2. Launch AST 2. In Diagnostic Console, select Trackpad Calibration Check from the list of diagnostic suites. For more information on AST 2, refer to [TP1279: AST 2 Supported Products and Tests](#).

**Caution:** The Trackpad Calibration Check suite is very sensitive to external disturbances. Ensure the computer is on a flat surface before you begin. Don't run the Trackpad Calibration Check suite if the computer is on a bench where other technicians are working. To avoid interfering with the results, be sure to place weights down gently on a separate surface while running the suite. If the computer is bumped or jostled while the suite is running, restart the test.

[< Diagnostic Results](#)

# Diagnostic Suites

## TRIAGE



### Trackpad Response

Assists in verifying functionality of trackpad.



3 minutes



## REPAIR



### Trackpad Calibration Check

Verifies calibration of the trackpad actuator and force sensor.

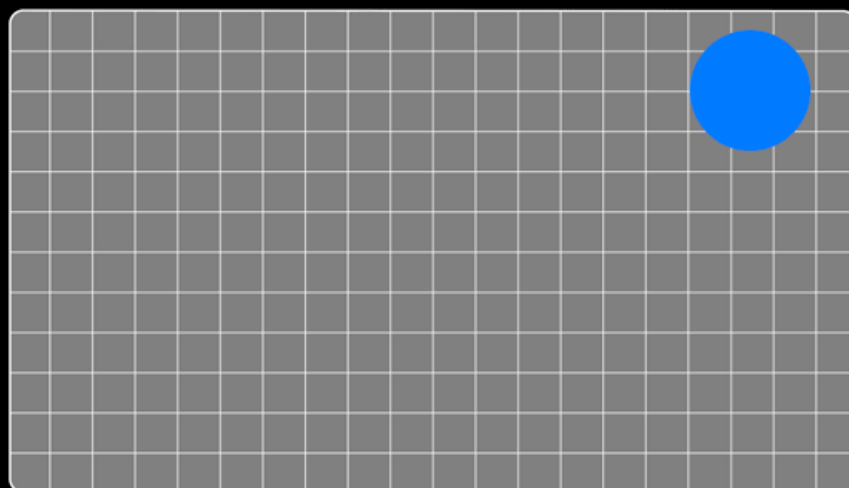


3 minutes



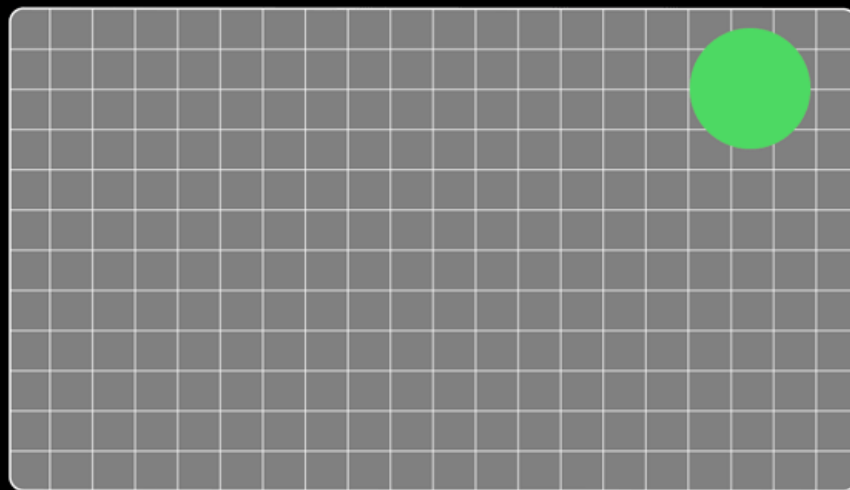
3. The Trackpad Calibration Check suite consists of several stages. The first stage of the suite is the Force Check, which is interactive and requires placing the 200 g and 800 g weights as indicated. The blue dot will indicate where on the trackpad to place each weight. The text at the bottom of the screen will indicate which weight to use at each step. The dot will turn green when it is time to lift the weight from the trackpad.

**Important:** Press an alphanumeric key to advance the test.



#### Test Instruction

Place the 200g weight on the indicated area and press any key.

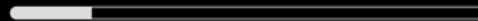


### Test Instruction

Remove the weight from the indicated area and press any key.

4. The next stage of the Trackpad Calibration Check suite is the Actuator Check. During this stage, the trackpad will make clicking sounds while the actuator is tested. If any issues with the actuator are identified, the suite may need to proceed to the next stage, which is the Actuator Calibration. The trackpad will continue to make clicking sounds while the actuator is calibrated. During this process, the unit under test (UUT) will display the screen shown below.

Checking your Mac...



5. If no issues are found, the screen will look like the image below. The trackpad calibration is verified.



About Device



Input Device

- ✓ Actuator Calibration
- ✓ Critical Error Test
- ✓ Open Test
- ✓ Force Check

6. If issues were found in the Force Check, Actuator Check, or the Actuator Calibration, the screen will look like the image below and the Trackpad Calibration Check suite should be run again. If the computer fails a second time, a top case replacement is recommended.



MacBook Pro  
C000094.02-01.00

# Issues Found

Trackpad Calibration Check  
October 20th, 2016 2:19 PM



About Device



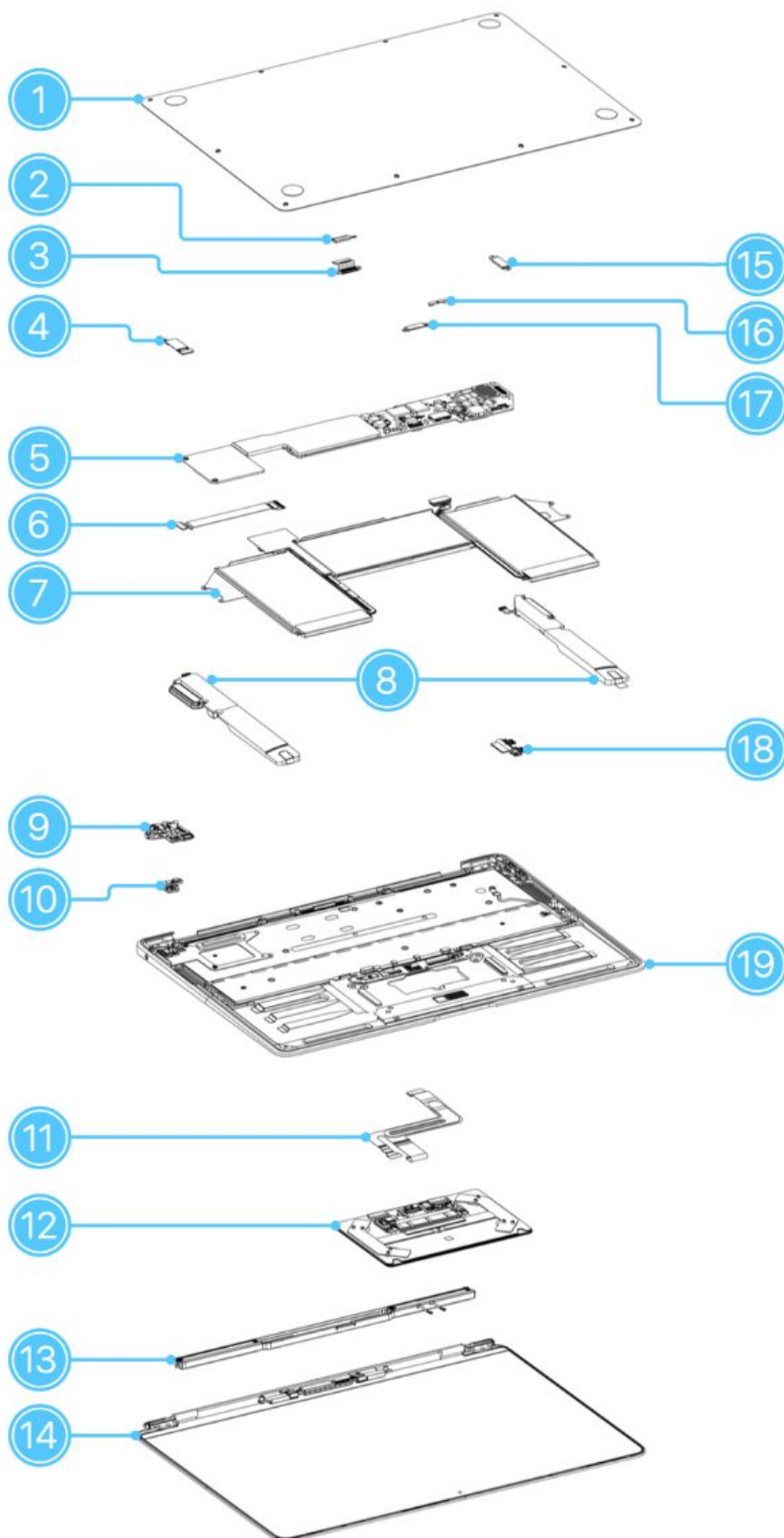
Input Device

- ✓ Actuator Calibration
- ✓ Critical Error Test
- ✓ Open Test
- ! Force Check



# Exploded View

## Exploded View for MacBook Air (M1, 2020)



### 1. Bottom Case

- 923-04300, Bottom Case, 7-core GPU, Space Gray
- 923-04301, Bottom Case, 8-core GPU, Space Gray
- 923-04302, Bottom Case, 7-core GPU, Silver
- 923-04303, Bottom Case, 8-core GPU, Silver
- 923-04304, Bottom Case, 7-core GPU, Gold
- 923-04305, Bottom Case, 8-core GPU, Gold

## **2. eDP Cowling**

- 923-04010

## **3. eDP Cable**

- 923-04718

## **4. Audio Board Cowling**

- 923-00604

## **5. Logic Board**

- 661-16809, M1, 7-core GPU, 8GB, 128GB
- 661-16810, M1, 7-core GPU, 8GB, 256GB
- 661-16811, M1, 7-core GPU, 8GB, 512GB
- 661-16812, M1, 7-core GPU, 8GB, 1TB
- 661-16813, M1, 7-core GPU, 8GB, 2TB
- 661-16814, M1, 7-core GPU, 16GB, 128GB
- 661-16815, M1, 7-core GPU, 16GB, 256GB
- 661-16816, M1, 7-core GPU, 16GB, 512GB
- 661-16817, M1, 7-core GPU, 16GB, 1TB
- 661-16818, M1, 7-core GPU, 16GB, 2TB
- 661-16819, M1, 8-core GPU, 8GB, 512GB
- 661-16820, M1, 8-core GPU, 8GB, 1TB
- 661-16821, M1, 8-core GPU, 8GB, 2TB
- 661-16822, M1, 8-core GPU, 16GB, 512GB
- 661-16823, M1, 8-core GPU, 16GB, 1TB
- 661-16824, M1, 8-core GPU, 16GB, 2TB

## **6. Audio Flex Cable**

- 923-03663

## **7. Battery**

- 661-16086
- 923-05102

## **8. Speaker (pair)**

- 923-03678

## **9. Audio Board**

- 923-03672, Space Gray or Gold
- 923-03673, Silver

## **10. Touch ID Board**

- 661-15412

## **11. IPD Flex Cable**

- 923-04008

## **12. Trackpad**

- 661-16825, Trackpad, Space Gray
- 661-16826, Trackpad, Silver
- 661-16827, Trackpad, Gold

## **13. Vent/Antenna Module**

- 923-04327

#### 14. Display Assembly

- 661-16806, Display Assembly, Space Gray
- 661-16807, Display Assembly, Silver
- 661-16808, Display Assembly, Gold

#### 15. I/O Board Cowling

- 923-04034

#### 16. Wireless Antenna Cowling

- 923-03994

#### 17. IPD Flex Cable Cowling

- 923-03995

#### 18. I/O Board

- 923-03553

#### 19. Top Case with Keyboard

- 661-16831, Top Case with Keyboard, Space Gray
- 661-16833, Top Case with Keyboard, Silver
- 661-16835, Top Case with Keyboard, Gold




**Note:** Regional top cases have the same base part number, but they include a language code prefix (for example, Italian = T661-16831). Be sure to choose the correct keyboard language when ordering a top case. To help determine the correct country code and keyboard language, refer to [HT201794: How to identify keyboard localizations](#). The language prefixes are:

- |                              |                            |
|------------------------------|----------------------------|
| • AB: Arabic                 | • KH: Korean               |
| • B: British (Great Britain) | • MG: Hungarian            |
| • BG: Bulgarian              | • N: Dutch                 |
| • C: Canadian French         | • PO: Portuguese           |
| • CH: Chinese Simplified     | • RO: Romanian             |
| • CR: Croatian               | • RS: Russian              |
| • CZ: Czech                  | • S: Swedish               |
| • D: German                  | • SF: Swiss French         |
| • DK: Danish                 | • SL: Slovak               |
| • E: Spanish                 | • SM: Swiss Multilingual   |
| • F: French                  | • T: Italian               |
| • FN: Belgian                | • TA: Taiwanese            |
| • GR: Greek                  | • TH: Thai                 |
| • H: Norwegian Bokmal        | • TQ: Turkish (Turkey)     |
| • HB: Hebrew                 | • TU: Turkish (Turkish)    |
| • IS: Icelandic              | • VN: Vietnam              |
| • J: Japanese                | • Z: English International |

Top case keyboards may not be available in all localizations.

# MacBook Air (M1, 2020) Screw Chart

## Screw Chart for MacBook Air (M1, 2020)

<p>923-05168, Silver 923-05165, Space Gray 923-05171, Gold</p> <p>Pentalobe</p>  <p>Bottom Case, Front Center and Sides (6)</p>	<p>923-05167, Silver 923-05164, Space Gray 923-05170, Gold</p> <p>Pentalobe</p>  <p>Bottom Case, Rear Corner, (2)</p>	<p>923-05169, Silver 923-05166, Space Gray 923-05172, Gold</p> <p>Pentalobe</p>  <p>Bottom Case, Rear Center (2)</p>
<p>923-04003 T3</p>  <p>Wireless antennas cowling (1), IPD flex cowling, eDP cowling, I/O board cowling (2)</p>	<p>923-03680 T3</p>  <p>Battery (2)</p>	<p>923-03679 T3</p>  <p>TCON (2)</p>
<p>923-04005 Torx T5</p>  <p>Audio Board (2)</p>	<p>923-02884 Torx T3</p>  <p>Audio Board (1)</p>	<p>923-02888 Torx T3</p>  <p>Touch ID Flexure (6)</p>
<p>923-03975 Torx T5</p>  <p>I/O Board (2)</p>	<p>923-02890 Torx T3</p>  <p>eDP to Logic Board (2)</p>	<p>923-03999 Torx T5</p>  <p>Logic Board (3)</p>

<p>923-05305 Torx T5</p>  <p>Logic Board (2)</p>	<p>923-04007 Torx T5</p>  <p>Logic Board (1)</p>	<p>923-03997 Torx T8</p>  <p>Display Clutch</p>
<p>923-04004 Torx T3</p>  <p>eDP Cowling (2)</p>	<p>923-04700 Torx T5</p>  <p>Vent/Antenna Module (4)</p>	<p>923-03002 Adjustable torque driver 0.3–1.2 Nm</p>  <p>Trackpad, Center</p>
<p>923-02880 10–34 Ncm torque driver” set to 16 Ncm</p>  <p>Trackpad</p>	<p>923-03850 Torx T3</p>  <p>Speaker (2)</p>	



# MacBook Air (M1, 2020) Screw Location Diagrams

## Screw Location Diagrams for MacBook Air (M1, 2020)

### Bottom Case

- Pentalobe: (position 1)
  - 923-05164, Space Gray
  - 923-05167, Silver
  - 923-05170, Gold



- Pentalobe: (position 2)
  - 923-05166, Space Gray
  - 923-05169, Silver
  - 923-05172, Gold



- Pentalobe: (position 3)
  - 923-05165, Space Gray
  - 923-05168, Silver
  - 923-05171, Gold

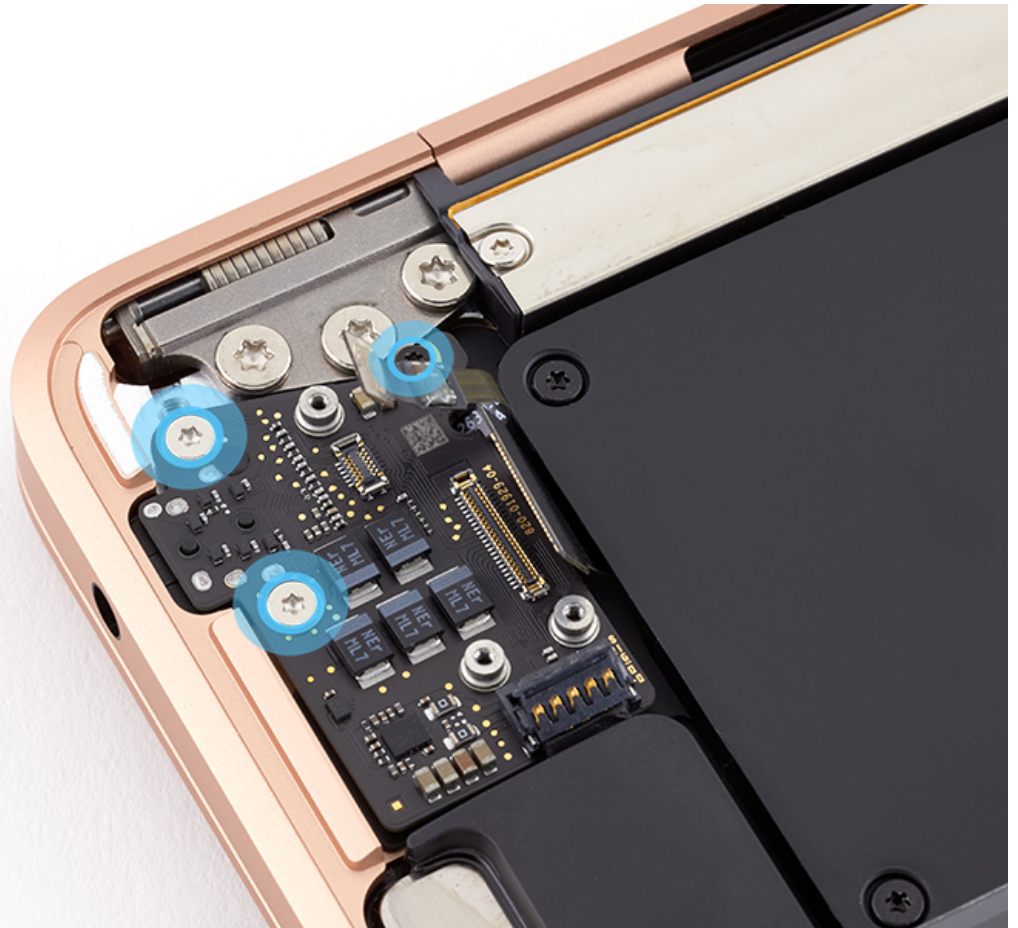


## Audio Board

- T3: 923-02884



- T5: 923-04005



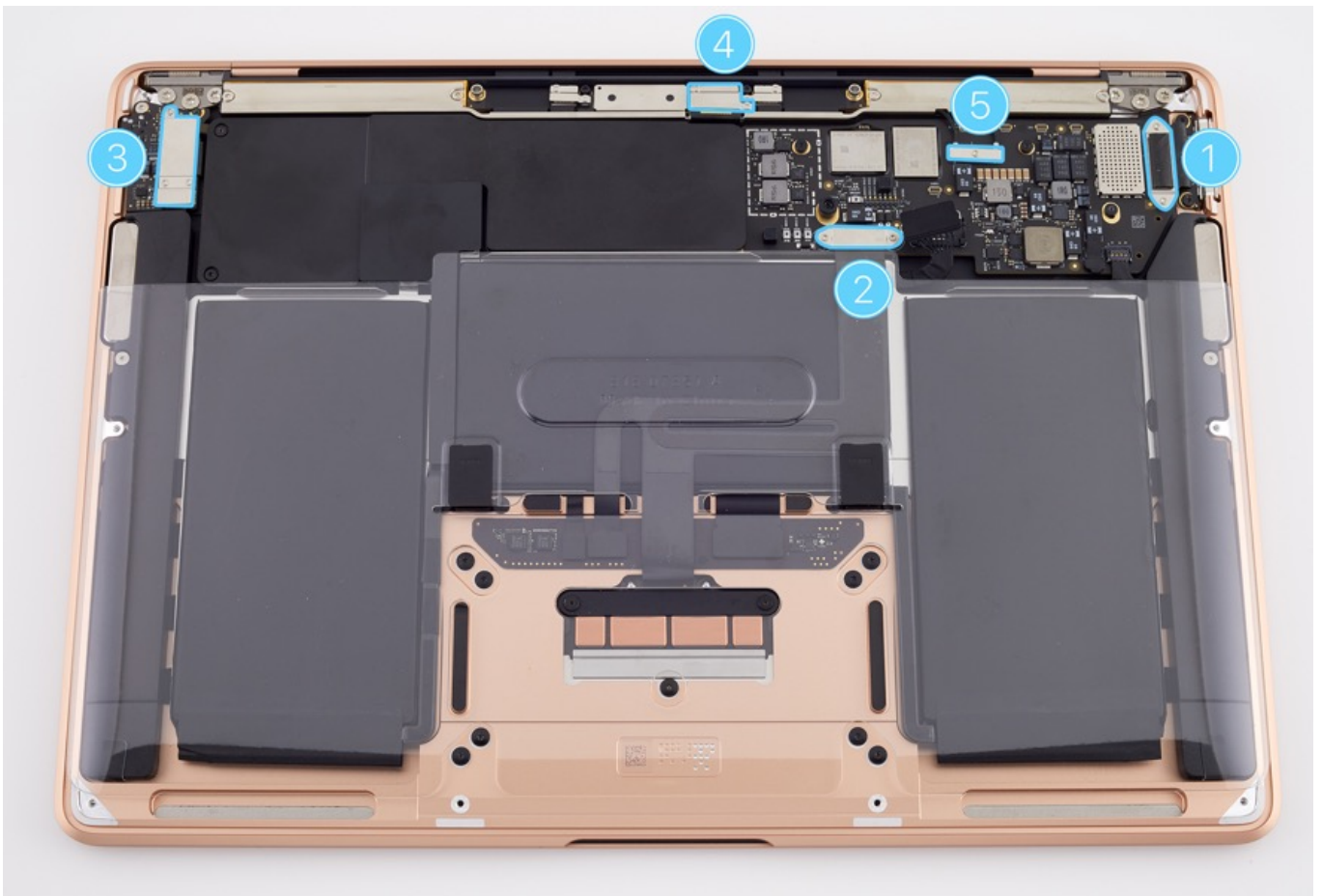
## Logic Board Cowlings

- T3: 923-04003



- T3: 923-04004 (number 4)

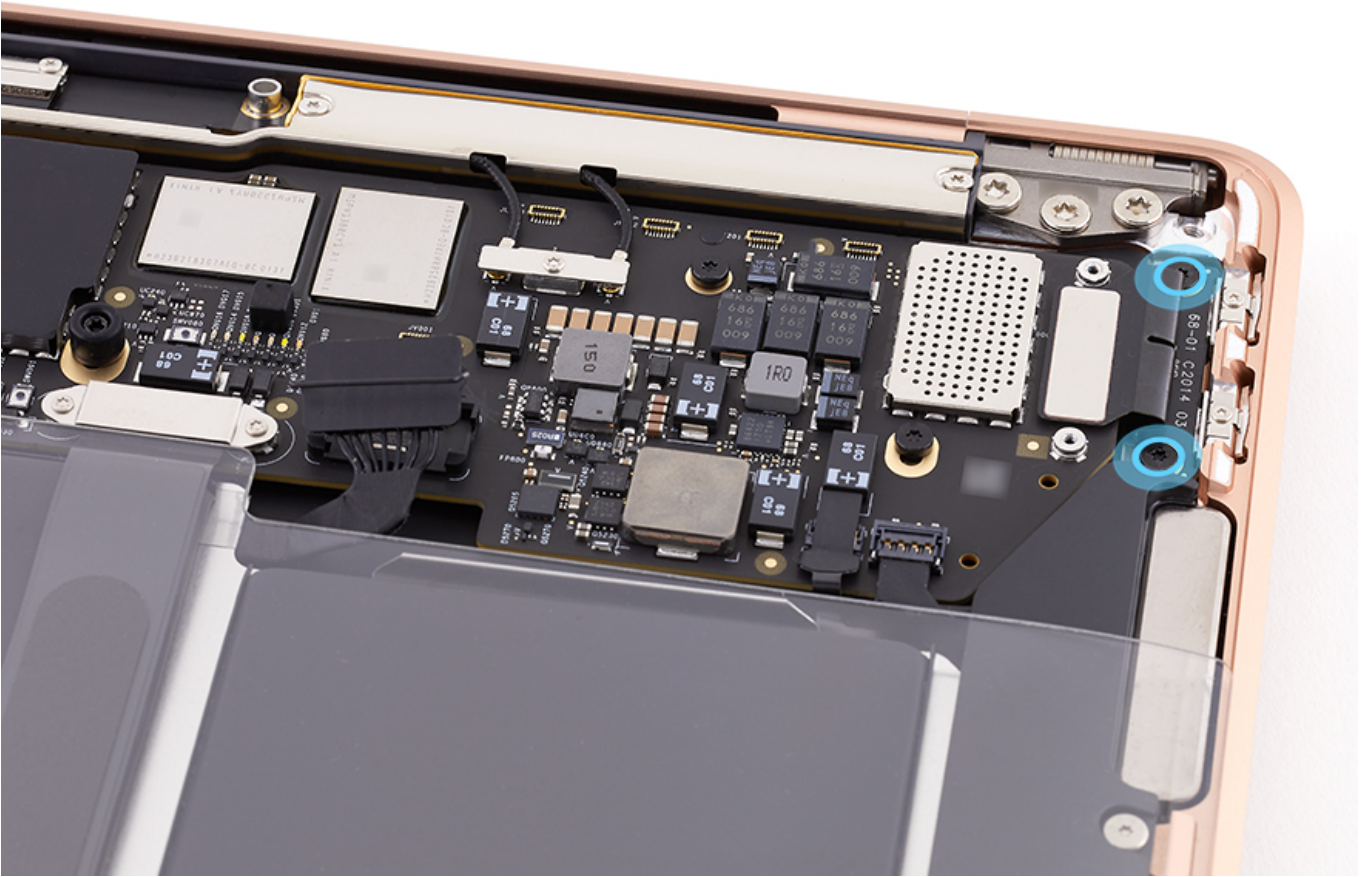




#### I/O Board

- T3: 923-03975



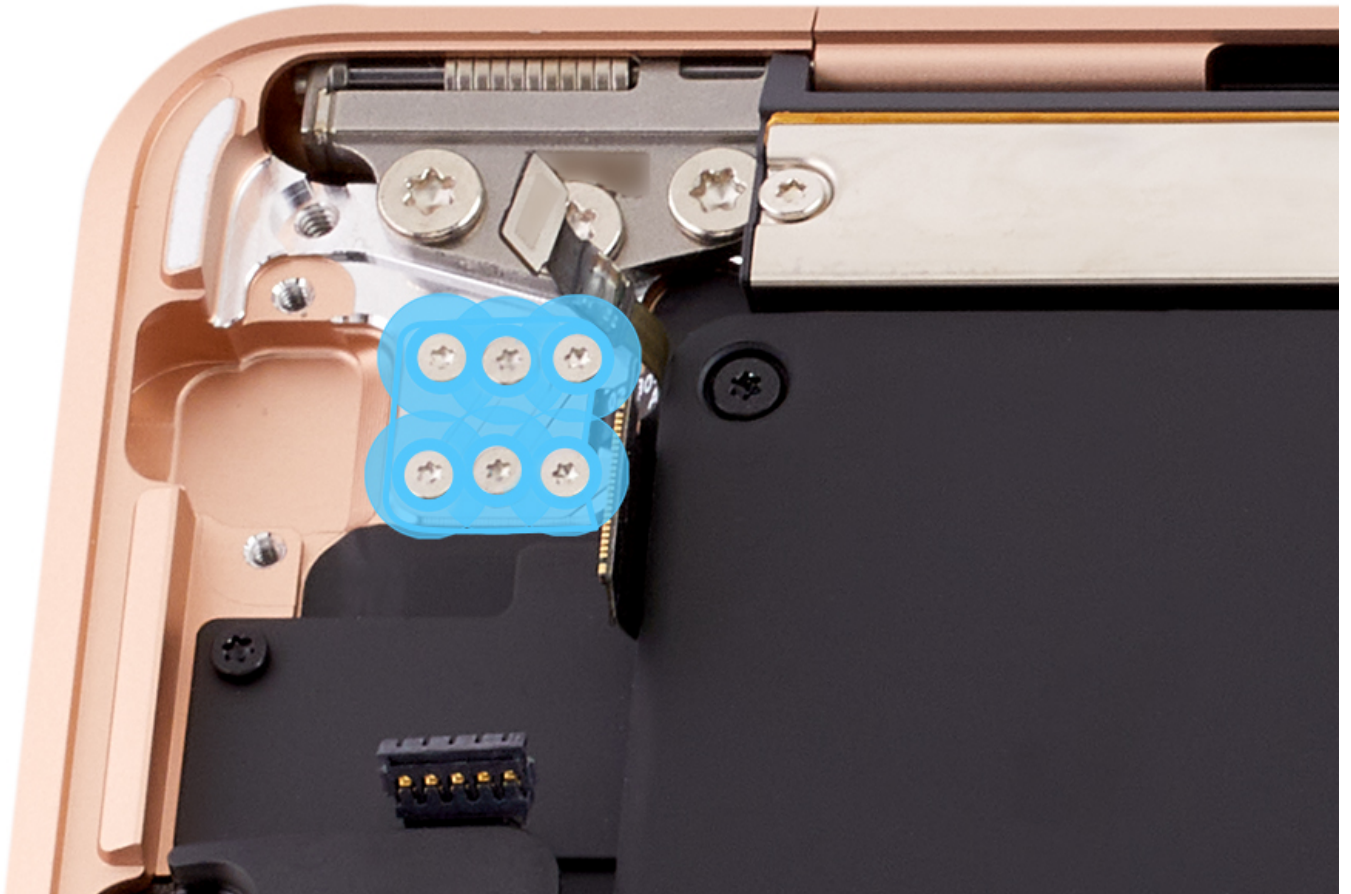


### Touch ID Flexure

- T3: 923-02888







### Logic Board

1 = T5: 923-05305



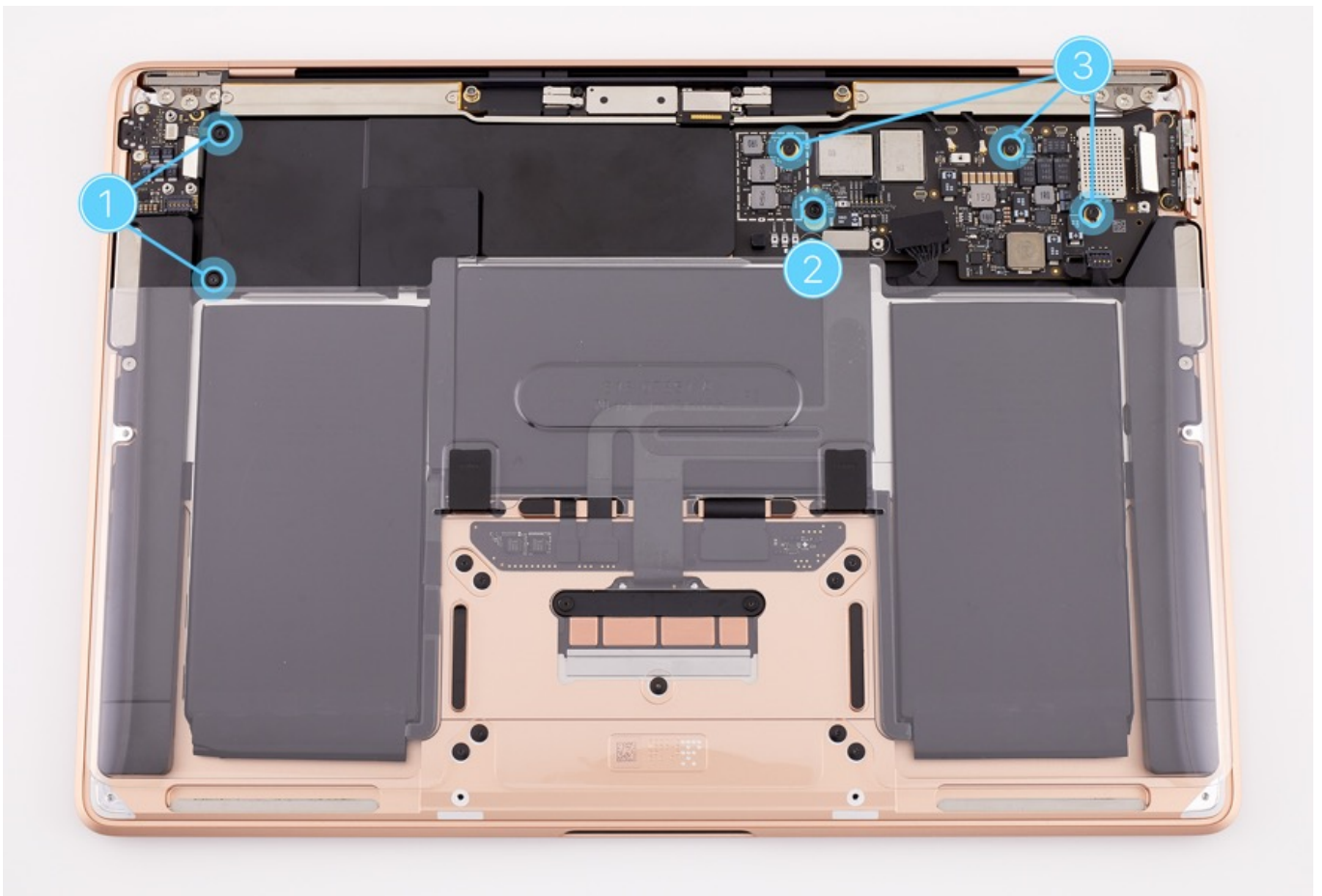
2 = T5: 923-04007



3 = T5: 923-03999





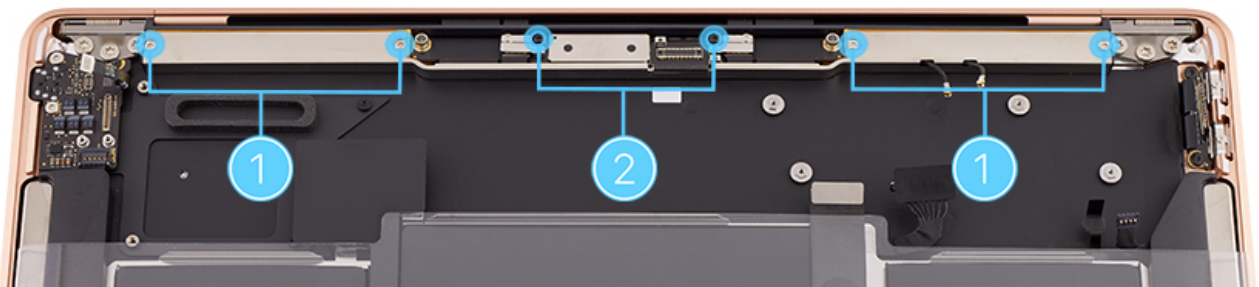


#### Vent/Antenna Module

- T5: 923-04700 (4) (position 1)



- T5: 923-03679 (2) (position 2)



#### Display Hinge

- T8: 923-03997





## Speakers

- T3: 923-03850



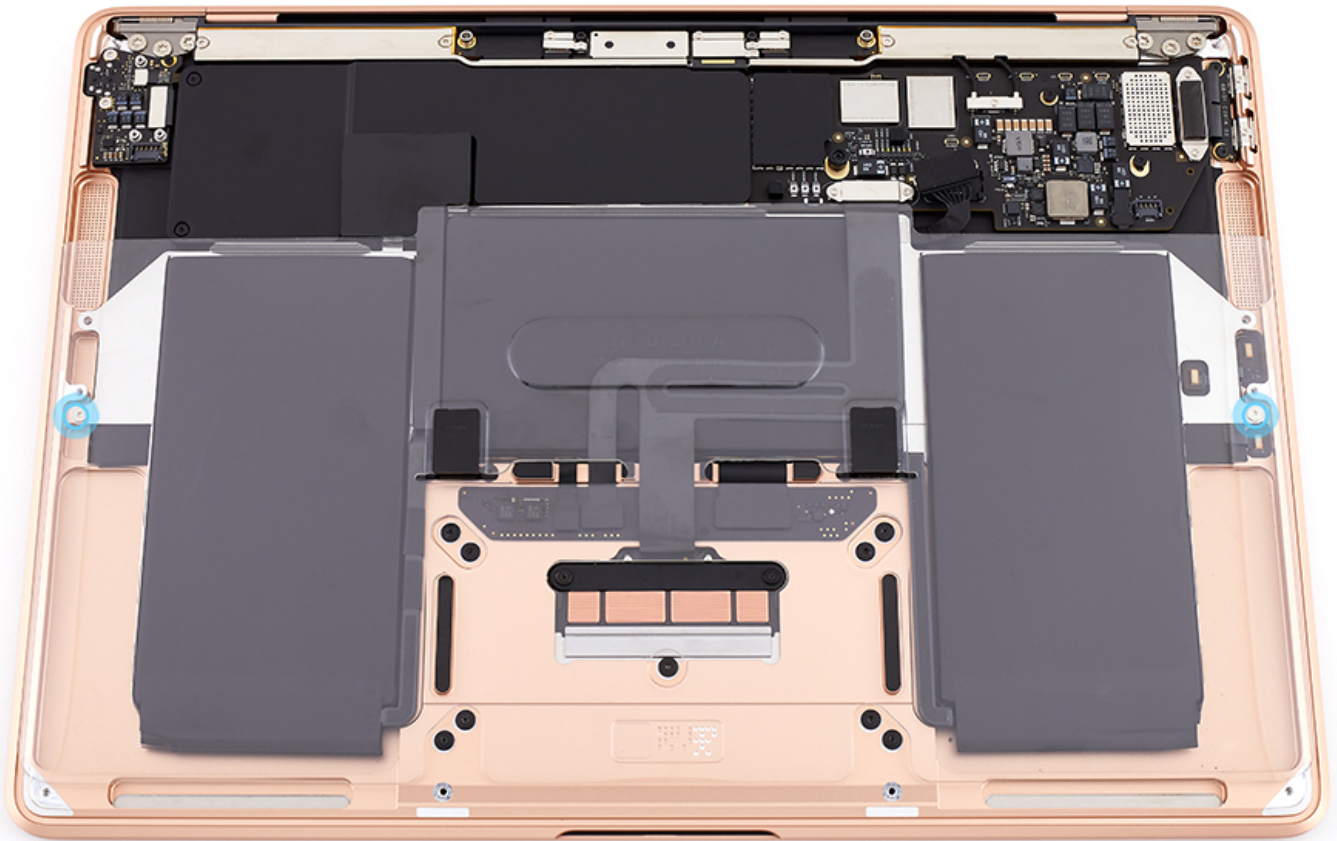


## Battery

- T3: 923-03680







## Trackpad

- T5: 923-03002 (center)



- T5: 923-02880 (outer)



